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Maximizing U.S. Interests in Science and Technology Relations with Japan

Report of the Defense Task Force

National Research Council

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Committee on Japan
Office of Japan Affairs
Office of International Affairs
National Research Council

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DEDICATION

Donald J. Atwood was a member of the authoring committee until his death in April 1994. Through his enthusiasm, active participation in committee meetings, and interactions with officials in Japan, Don made a major contribution during the early months of the study. His was a unique perspective on technology and policy issues based on a long and outstanding career at General Motors as well as his service as Deputy Secretary of Defense. The Defense Task Force was fortunate to have benefited from Don's experience and wisdom, and will miss his warmth and graciousness.

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Since 1985 the National Academy of Sciences and the National Academy of Engineering have engaged in a series of high-level discussions on advanced technology and the international environment with a counterpart group of Japanese scientists, engineers, and industrialists. One outcome of these discussions was a deepened understanding of the importance of promoting a more balanced two-way flow of people and information between the research and development systems in the two countries. Another result was a broader recognition of the need to address the science and technology policy issues increasingly central to a changing U.S.-Japan relationship. In 1987 the National Research Council, the operating arm of both the National Academy of Sciences and the National Academy of Engineering, authorized first-year funding for the Office of Japan Affairs (OJA). This program element of the Office of International Affairs was formally established in the spring of 1988.

The primary objectives of OJA are to provide a resource to the Academy complex and the broader U.S. science and engineering communities for information on Japanese science and technology, to promote better working relationships between the technical communities in the two countries by developing a process of deepened dialogue on issues of mutual concern, and to address policy issues surrounding a changing U.S.-Japan science and technology relationship.

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OVERVIEW

For many years, the U.S.-Japan security alliance has advanced the fundamental interests of both partners and contributed to ensuring peace and stability in the Asia-Pacific region and the world. The alliance played a key role in containing the Soviet Union during the Cold War, and continues to serve the interests of the United States and Japan as we approach the twenty-first century. For the United States, the alliance with Japan helps to prevent the rise of a hegemonic power in Asia, allows for forward deployment in the Pacific, and serves other geostrategic interests. For Japan, the alliance provides a basic security guarantee, substitutes for a more extensive and costly military capability, and facilitates friendly economic and political relations with Asian neighbors.

During the Cold War, technology cooperation played a significant role in the U.S.-Japan alliance. The United States maintained a policy of transferring important military technologies, mainly through licensed production programs, to encourage Japan to increase its own defense capabilities within the framework of the alliance. This arrangement was appropriate for the time and advantageous to both countries. Building on the technological and manufacturing base created through licensed production, Japanese industry is now able to produce the most advanced weapons, and can independently develop less sophisticated systems. Japanese industry has diffused know-how acquired through military programs to gain important footholds in certain high-technology commercial sectors such as aircraft and space, and has developed considerable strengths in a variety of commercial technologies with significant and growing defense applications.

The environment surrounding the U.S.-Japan alliance and defense technology cooperation has changed considerably. Most American and Japanese experts recognize the value of maintaining a strong bilateral alliance, but are unsure about how it will evolve in the future. The fall of the Soviet Union, questions about how China will exercise its growing influence, and security challenges left over from the Cold War, such as the continuing division of the Korean peninsula, combine to form an uncertain security environment in the Asia-Pacific region. Continuing large imbalances in the U.S.-Japan economic relationship and growing industrial rivalry have had a corrosive effect on goodwill between the two countries. The traditional pattern of defense technology cooperation involving a one-way flow of technology from the United States to Japan has been subjected to increasing scrutiny and criticism, but efforts to achieve greater reciprocity have had little impact to date, and at times appear to have resulted in greater stresses in the relationship.

The question of how the United States should manage scientific and technological relations with Japan so that U.S. security interests are protected and advanced in the future is more timely and important than ever. The Committee on Japan of the National Research Council organized the Defense Task Force to examine this question as part of a larger evaluation of U.S.-Japan scientific and technological interaction. In this assessment, the Defense Task Force has

considered several key issues, such as the outlook for the U.S.-Japan security alliance, including defense postures and capabilities, the technological needs and trajectories of the two countries, the historical experience with various forms of collaboration, and the policy context in the United States and Japan. Through this assessment, the Defense Task Force has developed several broad conclusions and specific policy recommendations that it believes will, if followed, help the two countries build the foundation for a new scientific and technological partnership that delivers clear mutual benefits and strengthens the security alliance, thereby advancing U.S. and Japanese interests in the years to come.

MAJOR FINDINGS

The central finding of the Defense Task Force is that future U.S.-Japan cooperation in defense and dual-use technology must involve greater reciprocity in technology flows than has been the case in the past. Enhanced reciprocal cooperation will require greatly expanded Japanese technological contributions to meeting U.S. and common security needs. Although the capabilities and fundamental interests of the United States and Japan make such a partnership feasible, significant obstacles remain. Overcoming these obstacles will require redoubled efforts and goodwill on the part of both countries.

Why Work Toward Technology Reciprocity?

The rationale that justified asymmetrical defense technology relationships no longer applies. During the Cold War, the United States treated defense technology as a commodity in relations with Japan—one-way technology transfers encouraged Japan to increase its defense capabilities and helped achieve other U.S. foreign policy objectives.

The Defense Task Force concludes that the international security and economic environment that exists today and is likely to prevail in the foreseeable future no longer justifies this traditional trade off with Japan. The United States has a continuing interest in enhanced Japanese contributions to the security alliance through expanded participation in peacekeeping activities, pursuit of foreign policy initiatives that serve common interests, the acquisition of improved defense capabilities within the framework of the alliance, and increased host-nation support. The United States also continues to have an interest in allowing Japan to purchase major U.S. systems off-the-shelf. However, the time has passed when defense cooperation featuring primarily one-way transfers of technology from the United States to Japan could be justified by U.S. security interests. In order for U.S.-Japan cooperation to advance U.S. interests in the future, it must feature greatly expanded Japanese technological contributions to U.S. and common defense needs.

In order for the U.S.-Japan alliance to continue to mature and develop, it must increasingly be characterized by cooperation that involves comparable contributions and mutual opportunities for benefit. Even if U.S. military security interests alone no longer provide a rationale for collaboration involving one-way transfers of technology to Japan, some might argue that such collaboration is worthwhile for other reasons. For example, Japanese licensed production of U.S. systems provides income to U.S. companies and helps amortize U.S. government research and development (R&D) costs, contributing resources that can be reinvested

in next generation technologies. Others would assert that one-way licensing deals are necessary in order to compete with European weapons contractors and indigenous Japanese development programs. Although these considerations have some validity and a defense technology relationship characterized by "technology-for-money" might be favored by some interests in both countries, the Defense Task Force believes that pursuing such an approach could undermine good relations and would not serve the long-term interests of either country.

In the long run, the U.S.-Japan alliance will be best served by defense technology collaboration that can stand close scrutiny and attract sustained support from the political leadership and broader publics of both countries. This implies a partnership in which contributions, risks, and opportunities to benefit from cooperation are comparable. For example, Japan has utilized the manufacturing and technology base benefits of licensed production to make important inroads in commercial industries such as aircraft, and has gained opportunities to refine technological capabilities originally developed to serve civilian markets. To build continued support for collaboration involving transfer of U.S. technologies to Japan—which inevitably also involves potential commercial risks for U.S. companies and opportunities for Japanese industry—it will be necessary to show that the United States is gaining similar opportunities to benefit from cooperation.

Japan's technological capabilities can increasingly contribute to U.S. security in the emerging environment. In addition to the above reasons for not maintaining the Cold War status quo in U.S.-Japan defense technology relationships, there is a strong positive case for the United States to pursue collaboration with Japan that features enhanced application of Japanese technologies to U.S. and mutual defense needs.

To begin with, even though the United States spends much more than Japan on developing defense-related technologies and systems, and Japanese capabilities in purely defense technology are limited, Japan has developed areas of significant expertise and strength, particularly in subsystems and components. Through a variety of mechanisms such as joint development of new subsystems, the incorporation of Japanese subsystems into U.S. systems procured by Japan (as in Japan's Aegis program), and joint upgrades of systems deployed by both countries (as is currently under discussion for the F-15), these Japanese strengths can be combined with U.S. technological contributions to deliver better performance and resource savings for both countries.

More importantly, Japanese industry is strong in a wide variety of technologies, such as advanced materials and optoelectronics, in which commercial product advances increasingly set the pace and are modified for use in defense systems. Several promising examples of U.S.-Japan cooperation in dual-use technologies and industries have been supported by the U.S. Department of Defense (DoD) and are discussed in this report. New mechanisms for encouraging industry-to-industry collaboration between the two countries could facilitate expanded application of Japanese commercial technologies to U.S. defense needs.

Although a perfectly balanced flow of technology in the defense relationship is not a realistic expectation for the foreseeable future, the Defense Task Force believes that more rapid progress toward greater reciprocity is necessary and achievable.

Previous Efforts and Initiatives Have Made Little Progress To Date

During the past 15 years, a number of efforts and initiatives have been launched to encourage a more balanced flow of technologies through U.S.-Japan defense cooperation, including the

establishment of the U.S.-Japan Systems and Technology Forum, the 1983 Memorandum of Understanding on Japanese defense technology transfers, U.S.-Japan codevelopment of the FS-X fighter, and the Technology-for-Technology (TFT) initiative recently pursued by DoD. The value of greater reciprocity in the defense technology relationship with Japan has been recognized in a variety of official statements and private sector reports. However, the Defense Task Force concludes that efforts to date have not resulted in significant Japanese technological contributions to U.S. national security.

Many, if not all, of the obstacles to enhanced reciprocal cooperation outlined in this report have been discussed and documented in previous studies. If past efforts have not resulted in significant progress, why might renewed efforts lead to more favorable results? The Defense Task Force believes that ongoing changes in the environment—such as downward pressure on U.S. and Japanese defense budgets, changing attitudes in Japan toward defense issues, and shifts in U.S. defense planning toward greater utilization of commercial technologies—could lead to greater incentives for cooperation on both sides. Additional efforts by both governments to improve the environment for cooperation can leverage these potentially favorable trends.

Overcoming Obstacles Will Require Focused Persistent Efforts

The major obstacles analyzed in the report include:

Asymmetries in capabilities and institutions for technology and industrial development that lead to U.S.-Japan differences in preferences regarding cooperative mechanisms. These asymmetries include U.S.-Japan disparities in the levels of defense R&D spending and in government-industry relationships and overall approaches toward technology and systems development. These disparities have led to different preferences regarding cooperative mechanisms, with the United States in most cases preferring off-the-shelf sales of U.S. weapons to Japan, and Japan mostly preferring indigenous development. Licensed production has often served as a compromise between these two preferences.

Changes in the budget and security environment hold the potential for reducing the impact of these barriers, particularly if new approaches toward applying Japanese commercial technologies to U.S. and mutual defense needs are pursued. However, the current interpretation and implementation of Japanese export control policies have been implicated in cases where Japanese companies have refused to license commercial technologies to U.S. industry, such as the refusal of Mitsubishi Heavy Industries to license technology related to its LE-5 rocket engine to McDonnell Douglas. More recently, the apparent unwillingness of Japanese manufacturers of flat panel displays to work with DoD on its special requirements also raises concerns. Clear Japanese government support for transfers of commercial technology from Japan to the United States could help to facilitate greater industry-to-industry cooperation.

Unwillingness of Japanese industry and government to cooperate technologically on reciprocal terms. The Defense Task Force believes that this is a real barrier, but is not intractable, given the proper incentives. Even in some cases where Japanese companies have cited Japan's arms export control policies as the reason for their unwillingness to cooperate with U.S. industry, it appears that these policies may have been raised only as an excuse, and the fundamental cause of this unwillingness has been a reluctance to license technology at arms length. In some areas of commercial technology, it appears that Japanese companies are becoming more open to reciprocal relationships, an encouraging trend. Consistent determination

on the part of the U.S. government to seek technology reciprocity in the defense relationship will be necessary to overcome this barrier. Positive incentives to encourage U.S.-Japan industry-to-industry cooperation can also contribute.

Lack of consistency and coordination in U.S. government approaches. Although the U.S. government has pursued more balanced technology flows in defense technology collaboration with Japan for roughly 15 years, these efforts have often been undermined by a lack of consistency and coordination. In light of the complexity and importance of the security relationship with Japan, the existence of disagreements between various players and a certain amount of infighting is understandable. However, the difficulties experienced in negotiating the codevelopment of the FS-X illustrate that U.S. approaches lacking consistency will increase the potential for putting stress on the overall alliance in the future. If technology reciprocity is not treated as a major focus at the outset of U.S. strategy-building toward specific programs, there is a danger that bilateral negotiations will preserve smooth working relationships but lead to agreements that perpetuate traditional asymmetries and fail the test of public scrutiny, ultimately resulting in increased strains on the relationship.

Some have pointed to a lack of interest on the part of U.S. companies in Japanese technologies as a major barrier to cooperation. Although increased sales, rather than technology acquisition, have been the main goal of U.S. defense companies collaborating with Japanese industry, this report documents a number of specific Japanese technologies and broad areas of technical achievement of interest to U.S. industry. The Defense Task Force believes that if barriers to reciprocal cooperation are lowered, this interest will be further activated, resulting in expanded cooperation.

Engaging U.S. and Japanese industry in the ongoing effort to build enhanced reciprocal technology cooperation to meet mutual security needs is critically important. In the long term, cooperation must be industry-implemented to a large extent, with effective U.S.-Japan industrial relationships as a prerequisite. However, the effort to lower barriers to cooperation cannot be "industry-led" because of the significant role of both governments as customers for defense technology and overseers of cooperative programs. Effective programs cannot be developed solely on the basis of pursuing the specific technological interests of U.S. companies. Individual companies are able to make their own trade-offs in pursuit of corporate interests. But reciprocity in defense technology cooperation with Japan is in the broader national interest, as outlined above. The keys to achieving it will be consistent U.S. government approaches formulated with the active participation of U.S. industry, and Japanese government and industry willingness to pursue a new structure for partnership and cooperation.

DEVELOPING A NEW APPROACH

Reducing and Eliminating Barriers to Cooperation

DoD should pursue technology reciprocity in the defense relationship with Japan as a major goal. Efforts to increase Japanese technological contributions to U.S. national security should focus on reducing and eliminating the barriers to enhanced reciprocal cooperation discussed in the report.

The U.S. government should seek to reduce or eliminate barriers to technology flow that result from Japanese policies. Japan's continued adherence to its arms export principles is consistent with U.S. interests. However, specific factors in interpretation and implementation have constituted barriers to greater Japanese technological contributions to U.S. and mutual security needs. *The United States should seek from the Japanese government (1) a clarification of the arms export principles and a public statement that export of items embodying substantially commercial technology that undergo minor modifications for defense applications are not restricted and (2) a change to the 1983 exchange of notes stating that Japanese military technologies transferred to the United States are exempt from retransfer restrictions, with changes addressing legitimate Japanese concerns and including provisions for the payment of royalties.*

DoD should work with the Japanese government and the private sectors of both countries to develop new mechanisms that facilitate technological collaboration between U.S. and Japanese companies to address common defense needs. *One promising approach would be a program to fund U.S.-Japan industry R&D on specific enabling technologies—including the adaptation of commercial technologies—targeted at applications in future weapons systems.* This jointly funded and managed program could be undertaken as an extension of the Systems and Technology Forum.

Integrating Enhanced Technology Cooperation and Alliance Management

During the current administration, the U.S. government has pursued several security-related initiatives with Japan, including TFT focused on technology relations, and recent discussions on the working management of security and defense cooperation (known as the Nye or Lord-Nye initiative). The failure of past efforts to achieve greater technology reciprocity highlights the need for persistent, integrated efforts now and in the future. In light of the ongoing uncertainties in the Asia-Pacific security environment and reevaluations of various aspects of security policy in both countries, it is important that the leadership of both countries focus on the long-term effectiveness of the alliance. The Defense Task Force believes that technology cooperation and related considerations need to be integrated into bilateral exchanges that set the overall tone and pattern for the future management and evolution of the alliance. *Therefore, the United States and Japan should institutionalize an enhanced comprehensive security dialogue featuring an integrated discussion of the political-military, economic, technological, and other aspects of the relationship.*

Organizing to Maximize U.S. Interests

DoD should ensure a coordinated approach in future collaborative defense programs with Japan. *One approach that might be adopted as a minimum is designating a single authority with the responsibility for coordinating strategies toward major systems in which collaboration with Japan is under discussion.* In the future, if conditions warrant it, DoD might consider adopting a more formal mechanism such as an International Programs Coordinating Council analogous to the Joint Requirements Oversight Council.

In cooperation with the U.S. Department of Commerce and other appropriate agencies, DoD should continue to build capabilities to monitor and manage dependence on foreign sources of

critical technologies, with the goal of ensuring U.S. access. Since dependence on foreign sources of products and technologies for U.S. weapons systems will be a continuing fact of life, ensuring access will remain a challenge, requiring a long-term focus. The correct approach to managing dependence on Japan will depend on the specific case and could involve pursuing understandings with Japanese government and industry, encouraging Japanese companies to build U.S. production facilities, or building a competitive U.S.-owned capability.

1
Introduction

Over the 50 years since the end of World War II, the U.S. security commitment to the Asia-Pacific region has played an important role in the peace and stability of the region and the world. The U.S.-Japan Treaty of Mutual Cooperation and Security has been a central element of that commitment. Vital American interests have been protected and advanced. Since early in this century, the United States has recognized an interest in preventing the Asia-Pacific region from falling under the control of a hostile power, and advancing this interest was closely linked with geopolitical containment of the Soviet Union during the Cold War. By supporting a largely favorable political and economic environment in the region through its military presence and open markets, the United States has contributed to unleashing the tremendous energy and vitality of the peoples and nations of the Asia-Pacific region, including Japan, as they have built the political and market structures necessary for stable international relations and rapid economic growth.

The United States continues to have vital security interests in the Asia-Pacific region.[1] However, the structure of the U.S.-Japan alliance, which was formed following the victory of communism in China and the outbreak of the Korean War, as well as the conventional mechanisms for formulating and implementing U.S. policies toward Japan, need to be reconsidered in light of recent radical changes in the international environment and the very different balance of economic and technological power that now exists between the two countries. Despite a long-term trend toward greater U.S.-Japan cooperation in the security realm, Japan's increasing strength in a number of critical high-technology industries, large and persistent bilateral trade imbalances, and a series of trade and investment disputes have convinced a broad section of the American public that economic and technological relations display a fundamental asymmetry of benefits and lack of reciprocity in favor of Japan. These underlying troubling trends have had a corrosive effect on the overall relationship.

With growing concern over the U.S.-Japan relationship focused on interactions in high technology and their effect on U.S. economic strength and national security, it has become apparent that U.S. interests in the relationship with Japan remain as critical as ever but are increasingly complex and multifaceted. Debate within the United States has revealed sharp differences in perspective over the priorities that different interests should have in U.S. policymaking and over alternative strategies for pursuing those interests. The end of the Cold War, while representing freedom from a major geopolitical threat, has been accompanied by significant uncertainties over the nature of the global security environment in the coming decades.

It was in this context that the National Defense Authorization Act for Fiscal Years 1992 and 1993 called for "a comprehensive assessment of the scientific and technological relations

[1]See William J. Clinton, "Remarks by the President in Address to the National Assembly of the Republic of Korea," July 10, 1993.

between the United States and Japan" by the National Academy of Sciences.[2] This report by the Defense Task Force focuses on U.S. national security interests at stake in science and technology relations with Japan, and was undertaken with support from the Department of Defense. In addition to this stand-alone report, the work of the Defense Task Force will be integrated with that of the Committee on Japan's Competitiveness Task Force into a final report supported by the Departments of Commerce, Energy, and State as well as the National Science Foundation. The final report will develop an overall framework for maximizing U.S. interests in science and technology relations with Japan.

How should the United States manage its scientific and technological collaboration with Japan so that its national security interests are protected and advanced through this interaction in the years ahead? That is the critical question addressed by this study. Reaching conclusions and developing recommendations have involved the examination of several important issues.

One key issue is the future of the U.S.-Japan security alliance and the evolution of U.S. and Japanese defense postures and capabilities. Particularly in defense technology cooperation, patterns of technology development, application, and transfer between the two countries have been profoundly influenced by the security environment. An understanding of the possible directions the alliance might take in the future and the likely implications will be necessary to set and achieve U.S. goals in science and technology interaction. During the time that the task force has been at work, future options for defense and security policy have been actively debated in both the United States and Japan. While many uncertainties remain, the outlines of these debates have become clearer in recent months. These questions are examined in Chapter 2.

A second key issue involves the specific goals and management of U.S.-Japan cooperation in defense technology cooperation, as well as interaction in dual-use technologies, mainly areas of commercial technology with defense applications.[3] The committee examined the current technological capabilities and trajectories of the two countries, the historical experience with various forms of cooperation, and the likely future needs of the two countries in terms of defense systems and underlying technologies. From this examination the committee has drawn conclusions on how defense and dual-use technology cooperation might be effectively managed in the future, including possible areas and mechanisms for U.S.-Japan cooperation and likely obstacles to achieving U.S. goals. These issues are examined in Chapters 3, 4, and 5.

During the course of the study, the Department of Defense has pursued its Technology-for-Technology (TFT) initiative with Japan.[4] The Defense Task Force has had an opportunity to learn about TFT and about other initiatives and collaborative programs that are being undertaken. Taken together, these important efforts on the part of the DoD and other U.S. agencies illustrate the significant challenges and opportunities we face in structuring scientific and technological

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[2]Committee on Armed Services, United States Senate, *National Defense Authorization Act for Fiscal Years 1992 and 1993* (Washington, D.C.: U.S. Government Printing Office, 1991).

[3]Dual-use technology is an increasingly important factor in overall U.S. strategy toward maintaining the technology base for future weapons systems and in thinking about U.S.-Japan relationships. The term "dual-use" can be applied in discussing several distinct sorts of issues. In this report we mainly refer to dual-use in two contexts (1) commercial technologies that can be used in military applications (such as flat panel displays and many other electronic components) and (2) broad areas of technological development and application that can have military and civilian uses (such as transport aircraft and space). To avoid confusion, we specify which context is being discussed throughout the report.

[4]Although not the subject of an official policy statement, this initiative has been discussed by DoD officials in various public fora. See Japan Economic Institute, "Washington Pushes for Expanded U.S.-Japan Defense Technology Exchanges," *JEI Report*, April 8, 1994.

interactions with Japan that produce mutual benefits. The task force has endeavored to draw appropriate lessons from this experience that will hopefully benefit U.S. policymakers as they pursue collaboration with Japan.

In Chapter 6, prospects for U.S. and Japanese technological needs, obstacles to achieving U.S. goals, and options for enhancing U.S.-Japan cooperation are reviewed and evaluated. Conclusions and recommendations are presented in Chapter 7. Additional information and assessment are provided in the appendixes.

This report and the resulting recommendations generally focus on issues and interests that come substantially under the purview of the Department of Defense and, to some extent, the Department of State. The committee is aware that a fundamental underpinning of the nation's security over the long term is our economic and overall technological strength. Further, the increasing industrial power of Japan and other nations relative to the United States poses important questions of how science and technology relations on the civilian side affect the political and military aspects of security.

Apart from pointing out areas where cooperative efforts between U.S. agencies or between U.S. government and industry would enhance U.S. national security, the task force has chosen to refrain from developing specific conclusions and recommendations on this set of issues. The links between competitiveness and security are recognized and examined, in areas such as managing the possible risks of dependence on Japanese technological capabilities for U.S. defense systems. This report also points to areas where the Department of Defense, in cooperation with other agencies of the U.S. government, could play an important role in enhancing national security and competitiveness. The Defense Task Force hopes that this report will be helpful to the Committee on Japan and the Competitiveness Task Force as they consider issues related to the competitiveness of U.S. civilian industries and perhaps develop specific recommendations related to U.S. economic interests and competitiveness.

2
Defining U.S. Interests

SUMMARY POINTS

• *The major factors that contributed to predictability and smooth management of the U.S.-Japan relationship during the Cold War are now largely gone. However, there are compelling reasons why maintaining the security alliance remains an important interest for both countries. Due to the correspondence of fundamental interests between the two countries and the importance of the U.S. market for Japan's economy, in addition to the U.S. security guarantee, the United States continues to enjoy leverage in the relationship.*

• *Shifts in the geopolitical environment and in the relative economic strength of the United States and Japan mean that the conduct of the relationship will inevitably change. Indeed, elements of the partnership have changed in recent years, mainly because the United States has begun to seek greater reciprocity in the relationship and the common Soviet threat has dissipated.*

• *Opportunities exist for the United States and Japan to build a stronger alliance as part of expanding regional institutions and discussions on security and in addressing global problems. However, the lack of a focused common threat, uncertainties about the future, and different perspectives on economic issues could lead to a cooler, more acrimonious relationship.*

• *Although there are a number of uncertainties concerning the security environment surrounding the U.S.-Japan alliance, the Defense Task Force believes that the time has clearly passed when defense cooperation featuring primarily one-way transfers of technology from the United States to Japan could be justified by U.S. security interests.*

HISTORICAL OVERVIEW

In the coming decades the United States and Japan will face a global security environment that is radically different from the one that prevailed during the Cold War. For most of the post-World War II period, the U.S.-Japan security relationship has been managed by specialists in each government in a fairly straightforward manner. The nature of "trade-offs" in the relationship and the terms of trade were stable and mutually understood. Two factors contributed to this stability. The first was an international environment in which key features, most importantly the Soviet threat, remained consistent over time. As a result, both the United States and Japan had a clear understanding of their own interests and intentions in the relationship, and each viewed the interests and intentions of the other as fundamentally compatible with its own. Consistency in the international environment contributed to predictability in the U.S.-Japan relationship.

The second factor was the basic asymmetry in the assets that each side brought to the relationship. Until fairly recently, Japan contributed mainly political assets (its importance as a strategic partner), while the United States brought economic, military, and technological assets.

As long as Japan's contribution was highly valued by the United States and America enjoyed a preponderance in economic, military and technological power vis-à-vis Japan, this asymmetry facilitated stable and mutually agreeable patterns of bargaining and trading.[1]

Although the United States encouraged the adoption in 1947 of Japan's "Peace Constitution," which contains in Article IX a renunciation of war as a sovereign right of the state, by 1950 concerns about Soviet military power and intentions had led the United States to alter its stance. From that time the major thrust of America's Japan policy was to work toward solidifying Japan's membership in the "Western" camp allied against Soviet expansion. One element of this policy involved encouraging Japan to increase its industrial and military capabilities. Another element was to work to ensure domestic Japanese political support for a continued U.S. military presence in Japan. U.S. forward deployment in Northeast Asia became important with the fall of China and the outbreak of the Korean War, and it has remained so. Japan became the key strategic partner for the United States in Asia, and the relationship has been seen as central to long-term Asian stability.[2]

Japanese policy has accommodated these American objectives. While opposition to large scale rearmament in Japan has continued over the postwar period, limited rearmament enjoyed initial support among Japanese conservatives, and the Self Defense Forces have gained greater public acceptance over time. The alliance with the United States and the stationing of U.S. forces in Japan have attracted vocal opposition in Japan at times. However, the alliance has generally enjoyed support across a range of policymakers and opinion leaders in Japan, as well as generally increasing support (or at least acquiescence) from the general public.

The Japanese conservatives of the Liberal Democratic Party, who enjoyed parliamentary majorities continuously from 1955 until 1993, pursued a policy of supporting the U.S.-Japan alliance and gradually increasing Japan's military capabilities.[3] Consistent support for the alliance, general acquiescence to U.S. political leadership in major international issues, and a forward position near the Asian land mass were the primary Japanese contributions to the U.S.-Japan relationship. In return the United States provided a security guarantee to Japan and tolerated asymmetrical economic and technological relationships because they were seen to advance overall U.S. interests.

Figure 2-1 illustrates the fundamental trade-offs in the relationship up to about 1980. From the standpoint of U.S. interests, the two salient points about this structure were (1) U.S. politico-military interests drove overall national strategy and policy toward Japan, and (2) in pursuing these interests, there was almost no opposition in the United States to trading off economic and technological assets, because prior to the late 1970s the United States was presumptively stronger than Japan economically and technologically.

During most of the 1950-1980 period, achieving market access and other concrete forms of economic reciprocity with Japan were not seen as important U.S. interests. Indeed, particularly in the early postwar years, providing economic and technological benefits to help build Japan into

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[1]Originally and as revised in 1960, the security relationship itself is fundamentally asymmetrical; the United States is obligated to come to the defense of Japan if the latter is attacked, but Japan is under no such obligation if the United States is attacked.

[2]See U.S. Department of Defense, *United States Security Strategy for the East Asia-Pacific Region* (Washington, D.C.: U.S. Government Printing Office, 1995), particularly p. 10.

[3]Conservative rule even preceded formation of the LDP. Except for a brief period when the Japan Socialist Party led the government, conservative parties held power in Japan from the time that elections were resumed during the U.S. occupation.

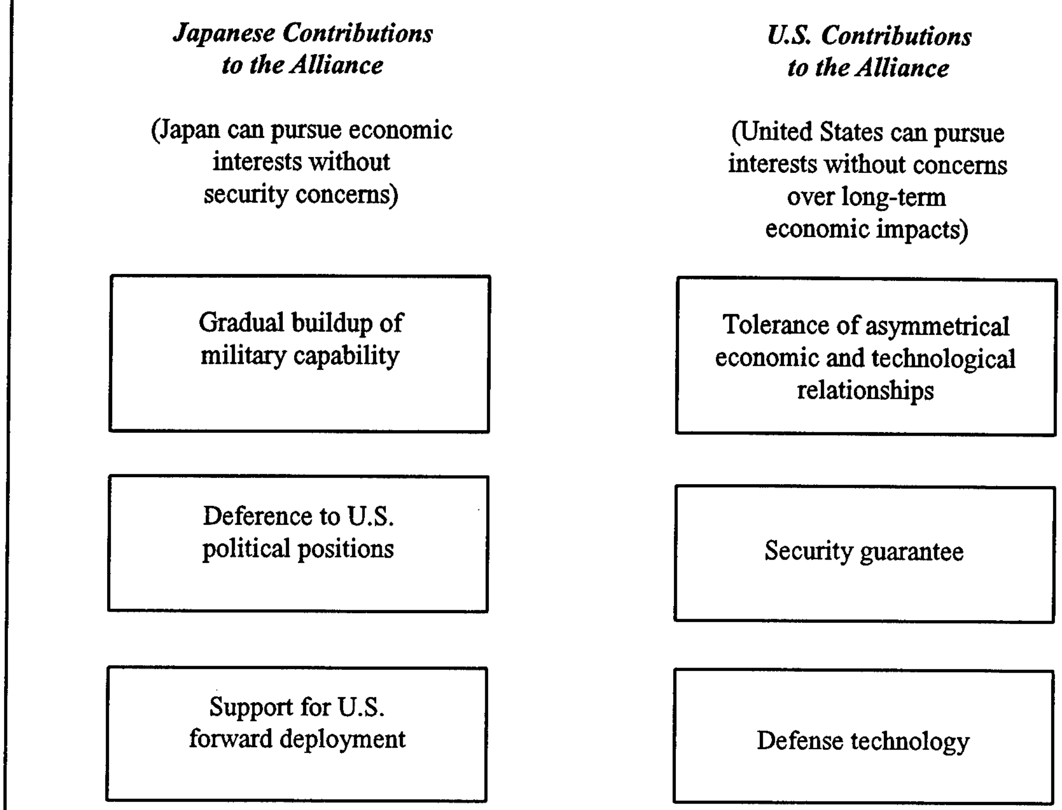

FIGURE 2-1 The U.S.-Japan relationship: Cold War status quo.

an Asian "bulwark of democracy" as a key component of Western economic muscle was seen as advancing fundamental U.S. strategic interests and was not perceived to be associated with any particular long-term costs. The United States followed a conscious policy of encouraging Japan's participation in the alliance by providing extensive economic benefits during the 1950s, benefits that provided a short-term boost to the Japanese economy and helped lay the foundation for rapid growth over the next several decades. Examples include providing access to the U.S. market and supporting Japan's membership in the General Agreement on Tariffs and Trade while tolerating restricted access to the Japanese economy and the U.S. military's "special procurement" of Japanese automobiles during and after the Korean War.[4] In addition, the U.S. government generally did not exert pressure on behalf of U.S. firms trying to break into the restrictive Japanese market during the 1950-1980 timeframe, even though such pressure would probably not have impaired the security relationship.[5]

Prior to the emergence of large bilateral trade deficits with Japan and the strong competitive pressure from Japanese firms on the U.S. consumer electronics, auto, and semiconductor

[4]See Jerome B. Cohen, *Economic Problems of Free Japan* (Princeton, N.J.: Princeton University, 1952). Also, Robert A. Pastor, *Congress and the Politics of U.S. Foreign Economic Policy: 1929-1976* (Berkeley: University of California Press, 1980), p. 98; Eiji Toyoda, *Toyota: Fifty Years in Motion* (New York: Kodansha International, 1985).

[5]See Mark Mason, *American Multinationals and Japan* (Cambridge, Mass.: Harvard University Press, 1992).

industries during the 1970s and 1980s, there was little interest among U.S. opinion leaders or the general public in U.S.-Japan trade or technology issues. Economic interests were not only subordinate, they were conceptualized in a different way than many Americans conceptualize them today. Reciprocity was not a consideration. There is still considerable debate and disagreement within the United States over exactly what our economic interests are in relations with Japan and how to go about pursuing them.[6]

Just as the structure of the U.S.-Japan security relationship during most of the Cold War appears, at least in retrospect, to have been relatively straightforward, so does the role of military technology. The transfer of military technology from the United States to Japan represented an inducement for Japan to rebuild its defense industrial base and procure systems consistent with an expanding defense capability within the framework of the alliance. Along with "off-the-shelf" purchases from the U.S. companies, Japan has produced a variety of aircraft and other U.S. weapons systems under license. While more expensive than exclusive reliance on purchases would have been, Japan has developed a relatively strong defense industrial base and dual-use technology base without making the large expenditures on indigenous systems that other U.S. allies, such as Great Britain and France, have made. U.S. arms makers have benefited from sales and licensing income, and Japanese industry has been a potent interest favoring expanding defense budgets and procurement.

Changes During the 1980s

Of the two factors that served as a foundation for easy management of the U.S.-Japan security relationship—the stable international environment and the disparity in U.S. and Japanese capabilities—it was the latter that shifted first. It took until the early 1980s for the change in relative power to register on the conduct of the relationship. The changes did not immediately affect the outcome of major decisions but instead were reflected in contentious debates over matters that had not been debated previously and in heightened interest in U.S.-Japan issues on the part of nonspecialists.

One interesting indicator of the suddenness in the change in thinking concerns Japanese licensed production of the F-15 fighter. When the U.S. government originally considered the issue in the late 1970s, most of those holding reservations were concerned with possible leakage of technology to third countries rather than economic competitiveness or unbalanced technology flows.[7] As a result, while the outflow of technology was carefully controlled, there were no technology flowback provisions written into the original government-to-government agreement. But by 1982, in recognition of the dramatic gains made by Japan in several important manufacturing industries, a U.S. General Accounting Office report explicitly raised the concern that F-15 technology transfers would help Japan develop a commercial aircraft industry that

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[6]A substantial segment of U.S. opinion, including many professional economists, holds that notions of competitiveness and reciprocity are not useful constructs for formulating U.S. economic policies and approaches to international economic relations. See Paul R. Krugman, "Competitiveness: A Dangerous Obsession," *Foreign Affairs*, March/April 1994, pp. 28-44. The opposing view is represented by Laura D'Andrea Tyson, *Who's Bashing Whom? Trade Conflict in High-Technology Industries* (Washington, D.C.: Institute for International Economics, 1992).

[7]The concerns in the interadministration debate were traditional ones, mainly the risk that sensitive technology would leak to the Soviets. See Michael Chinworth, *Inside Japan's Defense* (Washington, D.C.: Brassey's (US), Inc., 1992), p. 108.

could one day compete with the United States. Flowback provisions were then written into the agreement. In the intervening years, expanding Japanese trade surpluses and the rapid gains made by Japan's auto industry in the U.S. market raised America's awareness of Japan's economic and technological strength.

The increased Cold War tensions of the early Reagan years and the Nakasone cabinet's policy of pursuing a greater Japanese burden-sharing role in the security relationship served to ameliorate the impact of growing economic rivalry. One illuminating example that involved balancing U.S. economic and political-military interests, as well as divergent viewpoints over how economic interests should be conceived, is the 1983 decision of the Reagan administration to not take retaliatory action on a finding of unfair Japanese trade practices in the machine tool industry, following an appeal from Prime Minister Nakasone to the U.S. president. The U.S. political-military interest in the success of Nakasone's policy of making Japan an "unsinkable aircraft carrier" of the West carried the day, buttressed by the argument that all market outcomes—even those that result from large foreign government subsidies and trade barriers—should be accepted.[8]

Improved U.S.-Japan cooperation in military and strategic areas, including the acquisition of important new capabilities and increased host nation support by Japan, could not prevent more frequent and contentious debate in U.S. business and policy circles over U.S.-Japan economic relations from affecting the security relationship. Routine management of the security relationship by specialists outside the political spotlight became increasingly difficult during the 1980s. When the strategic threat posed by the Soviet Union—the other factor underlying stability in the U.S.-Japan relationship—began to evaporate in the late 1980s, so did the logic of interests and trade-offs illustrated in Figure 2-1 (at least on the U.S. side). The contrast between U.S. decisionmaking in the F-15 and FS-X cases, particularly the heightened concerns expressed in the FS-X debate in 1988-1989 about the possible risks to U.S. leadership in the commercial aircraft industry posed by transfer of military aircraft technology to Japan, illustrated that security concerns were becoming subject to wider scrutiny and debate and that economic interests could no longer be controlled or ignored by those managing the security relationship.[9]

THE NEW ENVIRONMENT

Recent American and Japanese analyses are in general agreement about the key features of the Asia-Pacific security environment for the next several years.[10] First, although the risk of great power conflict appears to be low at the present time, several of the world's major military powers have vital interests in the region, meaning that global and regional security concerns are highly

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[8]Ironically, the U.S. government granted some trade relief to the U.S. machine tool industry several years later because of national security concerns about growing dependence on foreign, particularly Japanese, machine tools. See Clyde Prestowitz, *Trading Places: How America Allowed Japan to Take the Lead* (Tokyo: Charles Tuttle, 1988), pp. 223-229 and pp. 244-246.

[9]See Chinworth, op. cit., pp. 132-161.

[10]See Admiral Charles R. Larson, Commander in Chief, U.S. Pacific Command, *United States Pacific Command: Posture Statement 1994* (Washington, D.C.: U.S. Government Printing Office, 1994) and Advisory Group on Defense Issues, *The Modality of the Security and Defense Capability of Japan: The Outlook for the 21st Century*, as translated in Patrick M. Cronin and Michael J. Green, *Redefining the U.S.-Japan Alliance: Tokyo's National Defense Program* (Washington, D.C.: U.S. Government Printing Office, 1994).

interdependent and that the course of great power rivalries and interests will impact on regional and global security.[11] The future political and economic development of Russia and China are two of the most significant long-term issues. The United Nations, the establishment by the Association of Southeast Asian Nations (ASEAN) of the ASEAN Regional Forum, efforts to realize a limited nuclear free zone in Northeast Asia, and other institutions and mechanisms aimed at ensuring global and regional security could also have an impact, although there are significant challenges in building more effective multilateral institutions.

A second feature of the environment is the existence of a number of potential trouble spots in the region that could flare up in coming years, with risks somewhat heightened by ongoing weapons modernization programs in several countries and in some cases by the proliferation of weapons of mass destruction. Some of these possible security challenges are left over from the Cold War. The Korean peninsula is the most obvious potential trouble spot in Northeast Asia. There are also several territorial disputes in East Asia, including the conflicting ownership claims to islands in the South China Sea. The relationship between Taiwan and China may also present security challenges.[12]

A third factor is the economic dynamism of much of the region, which is expected to continue and spread. Although progress in economic and political development will have beneficial impacts mainly in the long-term, economic rivalry of various forms between nations and perhaps groups of nations is also likely to grow and intensify. Currently, and for the foreseeable future, U.S.-Japan economic rivalry, along with some mutual concern about China, will be at the center of this trend. A key question is whether these rivalries and related disputes over trade, investment, and other issues can be managed to ensure that expanded commerce contributes to overall stability and security.

What are the implications of this environment for U.S. and Japanese security policies? In 1993, President Clinton articulated a vision for a New Pacific Community based on "shared strength, shared prosperity and a shared commitment to democratic values and ideals."[13] The security priorities for this New Pacific Community are (1) a continued American military presence in the Pacific, (2) stronger efforts to combat the proliferation of weapons of mass destruction, (3) a flexible approach to cooperation that may include new regional security dialogues as well as maintaining strong bilateral relationships, and (4) support for democracy and more open societies. As indicated in bilateral relations with Japan, China, and Vietnam, as well as in efforts to build the Asia Pacific Economic Cooperation forum, the Clinton administration has placed U.S. economic interests at the forefront of initiatives in the region.

Japanese security policy still operates officially under the National Defense Program Outline (NDPO) of 1976.[14] Although the process of political reform and realignment begun in 1993

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[11]For a wide-ranging analysis of security issues and future scenarios for the region, see Richard K. Betts, "Wealth, Power and Instability: East Asia and the United States After the Cold War," *International Security*, Winter 1993-94, pp. 34-77.

[12]See "China: New Menace or Misunderstood Miracle," *Far Eastern Economic Review*, April 13, 1995, pp. 24-30.

[13]See William J. Clinton, "Remarks by the President in Address to the National Assembly of the Republic of Korea," July 10, 1993.

[14]For an English translation of this document, see Japan Defense Agency, *Defense of Japan 1994* (Tokyo: The Japan Times, 1994), pp. 259-264. At this writing, it was not clear whether the Japanese government would replace the NDPO or when this might happen. News reports in the spring of 1995 indicated that JDA planners were preparing a draft for review by the cabinet. See "Kagaku Tero ni mo Sonae" (Even Provisions for Chemical Terrorism), *Nihon Keizai Shimbun*, April 16, 1995, p. 1.

continues, several important developments have occurred recently.[15] Perhaps most significantly, the Social Democratic Party of Japan (SDPJ) reversed two long-standing policy positions shortly after the formation of the Murayama cabinet in July 1994. The SDPJ now recognizes the Self Defense Forces as constitutional and favors continuation of the U.S.-Japan security treaty. These positions are now baselines in Japanese politics, agreed to by all major political forces except the Japan Communist Party.

Over the next few years the direction of Japanese security policy is likely to involve debate among several schools of thought.[16] One line of thinking, whose best-known advocate is Representative Ichiro Ozawa of the newly formed Shinshinto, or New Frontiers Party, envisions Japan developing into a "normal country" that plays an international role in political and military affairs commensurate with its industrial and financial strength. Most of those embracing this view favor a strong U.S.-Japan alliance but also advocate a significant boost in the capabilities of the Self Defense Forces, including those required for peace-keeping activities.

Another group, while favoring a Japanese role in U.N.-directed peace-keeping operations, would prefer that Japan's defense capability be maintained at a minimum level, perhaps even be cut or restructured, rather than significantly expanded, with some favoring creation of a non-SDF force to assist in emergency responses and natural disasters. Reliance on the alliance with the United States would continue. This group, which bridges a number of political parties and encompasses many subtle and not-so-subtle differences on policy specifics, envisions Japan's future role in global affairs as a "civilian power" to evolve on a trajectory from the present. The concept of "comprehensive security," which has developed in Japan over the past several decades and emphasizes development assistance, investment, and other nonmilitary means of pursuing national interests in world affairs, would be embraced by many in this group.[17]

As mentioned above, recent changes on the Japanese left have substantially marginalized those who would favor ending the U.S.-Japan security relationship, scrapping the Self Defense Forces, and pursuing some form of unarmed neutrality. Although some on the left might be active in pursuing a limited nuclear free zone in Northeast Asia or other initiatives, the more interesting developments in the coming years are likely to occur on the right.[18] During the Cold War, some measure of dissatisfaction with aspects of the alliance with the United States among the Japanese right (including conservative mainstream politicians such as former Representative Shintaro Ishihara as well as ultranationalist fringe groups) was subsumed under even greater antipathy for the Soviet Union. The absence of a Soviet threat made it possible for many members of the LDP to favor forming a coalition government in 1994 with their long-standing enemies in the SDPJ. Whether a significant group of Japanese conservatives stakes out a position seeking greater independence from U.S. foreign policy positions will be an important barometer to watch over the next several years.

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[15]For an overview, see John E. Endicott, *Japan, the Japanese and the World* (McLean, Va.: Brassey's Inc., forthcoming).

[16]See Michael J. Green and Richard J. Samuels, *Recalculating Autonomy? Japan's Choices in the New World Order* (Seattle: National Bureau of Asian Research, 1994).

[17]Sogo Anzen Hosho Kenkyu Gurupu, *Sogo anzen hosho senryaku* (A Strategy for Comprehensive National Security) (Tokyo: Okurasho Insatsukyoku, 1980).

[18] This is not to imply that a limited nuclear free zone would be supported only by the Japanese left; the initiative could potentially draw support from a fairly wide spectrum in Japan.

IMPLICATIONS FOR U.S. INTERESTS

While predicting or prescribing the future course of the U.S.-Japan security relationship is beyond the scope of this particular study, setting U.S. goals and policies for maximizing U.S. security interests in our scientific and technological relations with Japan requires a basic conception of those interests and some understanding of how the security relationship might evolve in the future.

Although it is currently not as essential to the security of either country as it was just a few years ago, the U.S.-Japan security alliance—with some of its explicit and implicit asymmetries—is very likely to be maintained since it clearly continues to serve the fundamental interests of both countries.

For the United States, the alliance and the presence of U.S. forces in Japan demonstrate the continuing commitment to the security of the entire region. Fundamental U.S. interests in Asia-Pacific security include (1) denying control of the region to a hostile power or coalition; (2) maintaining and enhancing U.S. economic access to the region, which is the fastest growing in the world; (3) guaranteeing the security of sea lanes vital to the flow of Middle East oil; and (4) promotion of democratic values and human rights.[19] In the short term, Japan is perhaps the only country with the economic and technological capabilities to constitute itself as a power able to overturn the Asian regional balance. A strong U.S.-Japan alliance helps prevent a significant expansion of the Japanese military, including acquiring a nuclear arsenal, and discourages Japan from assuming a political stance opposed to that of the United States. In the longer term, a continued U.S.-Japan alliance would serve to balance the emerging power of China, a resurgent Russia, or North Korea.[20]

Further, the security alliance with Japan does not impel the United States to spend anything on defense that it would not be spending anyway. Some would assert that it allows the United States to maintain its strategic position in Asia at reduced costs.[21] Also, Japan's increasing direct and indirect contributions to the alliance and global security should not be overlooked. In addition to the relatively high level of host-nation support that Japan provides for U.S. forces stationed there and Japan's financial contribution in support of Desert Storm, these contributions include increased aid to strategic U.S. allies such as the Philippines and Turkey during the 1980s, growing financial contributions to the United Nations, participation in peace-keeping operations in Cambodia and elsewhere, and "behind the scenes" support for various U.S. positions and initiatives. Some analysts also believe that the flow of portfolio and direct investment capital from Japan to the United States during the 1980s and early 1990s helped hold down U.S. interest rates and provided needed resources for productive investments.[22] The continuation of a strong

[19]U.S. Department of Defense, op. cit., especially pp. 5-7. It should be noted that there are those who argue that U.S. security commitments in Asia do not enhance economic access, and may indeed serve as a restraint on the aggressive pursuit of market access. See David B. H. Denoon, *Real Reciprocity: Balancing U.S. Economic and Security Policy in the Pacific Basin* (New York: Council on Foreign Relations, 1993).

[20]See Betts, op. cit.

[21]In any alliance the benefits of sharing burdens with allies come with the obligation to consult and coordinate, implying some constraint on pursuing independent foreign policy initiatives.

[22]Others point out that Japan's rise to the world's largest net creditor and America's simultaneous emergence as the largest net debtor has been "the source of considerable Japanese pride and sense of superiority toward the United States and the rest of the world." See Edward J. Lincoln, *Japan's New Global Role* (Washington, D.C.: The Brookings Institution, 1993), p. 59.

U.S.-Japan alliance is a critical element in the overall environment facilitating a growing, positive Japanese role in international affairs.

For Japan the relative benefits of the alliance are arguably greater. Some analysts have recently contended that Japan is in the midst of a major shift in foreign policy orientation, from a preoccupation with the United States to a focus on Asia, partly due to the growth in economic and technological linkages.[23] However, there are reasons to believe that a "turn toward Asia" that involves deemphasizing the U.S.-Japan alliance would not be a desirable long-term strategy for Japan. Even if Japan chooses to play a more active role in regional and global security affairs, the alliance with the United States will continue to serve as a substitute for an expensive indigenous military and military-industrial establishment. It is often pointed out that the alliance increases Japan's flexibility in Asian diplomacy, prevents a large-scale arms race in the region aimed at Japan, and enhances Japanese economic access to the region. Recognition of Japan's technological and industrial capability to field a formidable military force and doubts that Japan has come to terms with its past are underlying themes in relations with a number of Asian countries.[24] There is also potential for heightened economic friction between Japan and its Asian neighbors.[25] The possible consequences of a rupture in the U.S.-Japan security relationship—an isolated and rapidly rearming Japan setting off an Asian arms race and the formation of counter-strategies by countries in the region—would not be attractive to Japan or to other countries in Asia.

Beyond the baseline assumption that the alliance will continue for the foreseeable future, however, there is a range of possible directions that the relationship might take, each with different implications for cooperation in defense technology and for U.S.-Japan scientific and technological interactions more broadly. Domestic politics in both countries as well as the security environment in the Asia-Pacific region will affect the future course of the alliance. A number of concrete variables can be identified.

Defense Budgets

Barring a sudden shift for the worse in the global security environment, downward pressure on both U.S. and Japanese defense budgets is likely to continue. In Japan, for the past several years, this has meant essentially flat budgets, while in the United States it has involved significant cuts.[26] Still, U.S. defense spending will remain much greater than Japan's.

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[23] Some analysts believe that Japan is increasingly central to an emerging hierarchical industrial structure in Asia, particularly in critical industries such as electronics. See Mitchell Bernard and John Ravenhill, "Beyond Flying Geese: Regionalization, Hierarchy and the Industrialization of East Asia," *World Politics*, January 1995, pp. 171-209. The counterargument is presented by Edward M. Graham and Naoko T. Anzai, "The Myth of a De Facto Asian Economic Bloc: Japan's Foreign Direct Investment in East Asia," *The Columbia Journal of World Business*, Fall 1994, p. 6.

[24] This is illustrated by debates and uncertainties surrounding Japan's nuclear weapons capabilities and intentions. See Satoshi Isaka, "Going Nuclear Not an Option, Asserts Government," *The Nikkei Weekly*, August 15, 1994, p. 4.

[25] In the economic sphere, for example, despite growing Japanese development assistance and direct investment in the region, access to the Japanese market continues to be an issue for Asian countries, as it is for the United States. Japan runs trade surpluses with most Asian countries, and its surplus with the Southeast Asian region grew from \$20.6 billion in 1989 to \$53.6 billion in 1993. See Ministry of Finance statistics compiled by Japan Economic Institute, *JEI Report*, No. 35A, September 16, 1994, p. 21.

[26] In the United States, Republican victories in the 1994 midterm elections imply that these cuts may be less severe than had been planned when the Democrats controlled Congress and the presidency. The defense budget

Obviously, defense spending patterns in both countries will have a significant impact on opportunities for technology cooperation, which is explored in detail elsewhere in this report. However, in the absence of the serious geostrategic threat represented by the Soviet Union, it is the judgement of the Defense Task Force that the time has passed when defense cooperation featuring primarily one-way transfers of technology from the United States to Japan could be justified by U.S. security interests in areas such as increased Japanese defense procurement.[27]

Defense Capabilities

In a recent report to the prime minister, a Japanese private sector advisory committee endorsed exploring a number of new capabilities for Japan, such as reconnaissance satellites and other forms of intelligence capability, long-haul transport, in-air refueling, and theater missile defense.[28] Given budget pressures, Japan is unlikely to acquire all of these capabilities in the near term and will be setting priorities. In the more detailed discussion below, we consider some of the factors likely to influence specific decisions.

What Sort of U.S.-Japan Security Alliance?

It is possible to conceive of a number of scenarios for the concrete substance of the U.S.-Japan alliance. Although it is possible that both countries will increasingly link their foreign policy initiatives to the United Nations or emerging regional fora such as the ASEAN Regional Forum, developments over the past several years illustrate the significant barriers that exist to building effective multilateral institutions. Alternatively, Japan might take a stance that, vis-à-vis its Asian neighbors, is more independent of the United States. Under this scenario, the U.S.-Japan alliance would be maintained largely because of the negative impacts associated with ending it rather than any positive commitment by the two countries to the joint pursuit of shared goals and values in world affairs. It is also possible that the United States and Japan will build the "global partnership" aspects of the relationship, such as cooperation to help alleviate global environmental problems. Some opinion leaders in Japan have expressed the view that the most important future role for the U.S.-Japan alliance is as a foundation underlying Asian security, with some advocating expanded U.S.-Japan efforts to build multilateral dialogue and institutions.[29] Recent discussions between U.S. and Japanese officials that have become known as the Nye or Lord-Nye initiative have been aimed at ensuring the long-term cohesion of the security alliance.[30]

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debate will revolve around priorities and the amount of planned cuts that might be restored, not the overall trend, which is down.

[27]The United States continues to have an interest in the composition of Japan's defense budget and individual items, such as host-nation support.

[28]Advisory Group on Defense Issues, op. cit.

[29]The Institute for International Policy Studies and the Center for Naval Analyses, *The Japan-U.S. Alliance and Security Regimes in East Asia*, January 1995.

[30] See Joseph S. Nye, Jr, "Leadership and Alliances in East Asia," speech before the Japan Society, New York, May 11, 1995.

The Course of Economic Relations

Although the large and persistent trade and investment imbalances constitute the central feature of the overall U.S.-Japan relationship in the minds of most Americans, there is considerable disagreement in the United States over the causes, desirable remedies, or even the ultimate importance of these imbalances. Further, in contrast to security interests, which are defined and pursued by a few key agencies in each country and thus at least theoretically amenable to straightforward policymaking and implementation, economic interests are defined and pursued mainly in the private sector by millions of Americans in their roles as consumers and producers.

Still, since U.S. economic strength ultimately provides the foundation for national security, defining and pursuing economic interests should not pose a conflict with security interests in the long term. There is no reason for the United States to refrain from pursuing reciprocal access to markets and technology with Japan and other nations if this advances overall U.S. strategic interests. As discussed above, the "terms of trade" illustrated in Figure 2-1 have already shifted somewhat.

Managing the economic, security, and global partnership aspects of the U.S.-Japan relationship is likely to be challenging for both countries in the coming years. In particular, the long-term course of economic interactions and how both sides perceive the balance of mutual benefits will continue to have a significant impact on the overall atmosphere for cooperation. Leaders in both countries will continue to reevaluate the role of the alliance. Despite the challenges to effective management, however, the U.S.-Japan security alliance and other aspects of the overall relationship continue to serve the fundamental interests of Japan, and the United States continues to have leverage in the relationship as a result. For.reasons that will be explored in the following chapters, however, exercising this leverage in defense technology relationships is by no means easy or straightforward.

3

The Context for U.S.-Japan Defense and Industrial Technology Cooperation

SUMMARY POINTS

- *U.S.-Japan defense and industrial technology cooperation takes place within a context of wide and persistent imbalances in the overall science, technology, investment, and trade relations between the two countries.*
- *Although cooperation in the defense technology area itself has also been asymmetrical, for most of the post war period this pattern has been judged by both countries to advance their respective national interests.*
- *Enhanced reciprocal U.S.-Japan technology relationships could make an important contribution to maintaining and strengthening the alliance. However, changing traditional patterns of interaction has been difficult. Despite efforts over a number of years, Japanese military technology transfers to the United States have not been significant and have not measurably contributed to U.S. capabilities.*

PATTERNS AND TRENDS IN OVERALL U.S.-JAPAN SCIENCE AND TECHNOLOGY RELATIONS

In an issues paper published in 1990 the National Research Council's Committee on Japan called attention to the persistent imbalances in the science and technology relationship between the United States and Japan and to the structural features of the innovation and market systems of the two countries that underlie those imbalances.[1] The committee also underscored the importance to the overall U.S.-Japan relationship of increasing the flow of Japanese technology to the United States, as well as improving the utilization of Japanese technology to produce concrete benefits for U.S. national security and economic well-being. Throughout the post-World War II period and even prior to the war, the bilateral science and technology relationship has been characterized by several distinct patterns of interaction: (1) technology flows predominantly from the United States to Japan; (2) licensing fees and royalties flow predominantly from Japan to the United States; (3) the flow of technical personnel for long- and short-term visits aimed at training, education, and technology acquisition has been predominantly from Japan to the United States; and (4) the predominant flow of technology personnel for short-term stays to teach is from the United States to Japan and has been for over 125 years.

During the 1970s and 1980s, an additional pattern emerged—a large Japanese merchandise trade surplus with the United States and the rest of the world, with high-technology and other

[1]National Research Council, Committee on Japan, *Science, Technology, and the Future of the U.S.-Japan Relationship* (Washington, D.C.: National Academy Press, 1990).

manufactured products making up the bulk of that surplus. U.S. firms in a number of industries have faced formidable competition from Japan, and in the 1980s Japanese manufacturers solidified their export success with U.S. acquisitions and other direct investments. By the late 1980s, stagnant U.S. productivity growth, large trade deficits, and setbacks for U.S. high-technology companies in several global industries, combined with the rapid and marked success of Japan along these same parameters, gave rise to considerable concern and anxiety about the future among many Americans. The need for U.S. companies and the United States as a country to develop new ways to cope with the rise of Japan as an economic and technological superpower had become obvious and compelling to some.

Over the past few years, several factors have combined to produce a somewhat lower anxiety level in the United States regarding our economic and technological future and our standing relative to Japan. To begin with, the U.S. economy has enjoyed a cyclical recovery from the recession of the early 1990s at the same time that the Japanese economy has experienced its most prolonged economic recession since postwar reconstruction. In addition, a number of U.S. companies in industries that have faced intense pressure from Japanese competitors—such as automobiles and semiconductors—appear to have achieved significant turnarounds in terms of manufacturing prowess and product design.

However, large imbalances in U.S.-Japan technological and economic relations remain, as illustrated in Tables 3-1, 3-2, 3-3, and 3-4. Since these imbalances are caused by long-standing characteristics in the innovation and market systems of the two countries, it will likely require significant time and effort from both sides before imbalances are substantially ameliorated.

The U.S. innovation system, particularly since World War II, has been characterized by a number of interrelated structures and institutions that have served to establish and maintain U.S. leadership in basic science and technology development across a wide range of fields.[2] The main features of this system are (1) a high percentage of U.S. research and development (R&D) has been funded by the federal government during the postwar period (currently about 40 percent, but it has been as high as two-thirds); (2) a large proportion of this federal investment has been targeted at agency missions, with defense traditionally accounting for 50 percent or more; (3) in contrast to other countries, well over half of federally funded R&D has been performed in private institutions (primarily industry and universities) rather than in government laboratories; (4) while the proportion of funding devoted to basic, investigator-driven research in universities and private institutes is not large relative to the total federal R&D budget, the absolute amount is quite large, particularly in comparison with similar investments by other countries; and (5) new, start-up companies have played a major role in commercializing new technologies.[3]

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[2]For a concise overview, see David C. Mowery and Nathan Rosenberg, "The U.S. National Innovation System," in Richard R. Nelson, ed., *National Innovation Systems: A Comparative Analysis* (New York: Oxford University Press, 1993), pp. 29-75.

[3]For R&D funding and spending patterns, see National Science Board, *Science and Engineering Indicators 1993* (Washington, D.C.: U.S. Government Printing Office, 1993), particularly Chapter 4. Although information necessary to make direct international comparisons of national government support for investigator-driven basic research is not available, U.S. government support for basic research performed in universities, nonprofits, and federally funded research and development centers administered by universities and nonprofits was about $8.5 billion in 1991, or roughly 14 percent of U.S. government R&D spending. Converted at market exchange rates, this would be equivalent to 45 percent of the Japanese government R&D budget and over 50 percent of the German government R&D budget.

TABLE 3-1 Flow of Technology: Royalties and License Fees Generated from the Exchange and Use of Industrial Processes with Unaffiliated Foreign Residents, million dollars

	U.S. Receipts from Japan	U.S. Payments to Japan	U.S. Surplus	Ratio of Receipts/Payments
1990	1,028	141	887	7.3
1991	1,219	138	1,081	8.8
1992	1,268	145	1,123	8.7
1993	1,392	194	1,198	7.2

NOTE: Figures do not include transactions between affiliated foreign residents.
SOURCE: U.S. Department of Commerce, *Survey of Current Business*, September 1994.

TABLE 3-2 Flow of Research and Technical Personnel Between Japan and the United States by Purpose, 1988 and 1992

	1988	1992
Japanese in the United States		
For academic research	9,182	29,857
For study, training, and technology acquisition	43,042	76,023
Total	52,224	105,880
Americans in Japan[a]		
For study	1,993	2,600
For training	531	330
For teaching	1,131	1,778
For cultural/academic activities	785	14
To provide technology	28	
For research		432
For technology		1,968
For skills		78
Total	4,468	7,200
Ratio of Japanese in the United States to Americans in Japan	11.7	14.7

[a] The Ministry of Justice changed its classification categories for foreigners entering Japan between 1988 and 1992.
SOURCES: Japan Ministry of Justice, *Annual Report of Statistics on Legal Migrants, 1993* (Tokyo: Okurasho Insatsukyoku, 1993), and Akio Nishimoto and Hajime Nagahama, *Wagakuni to Kaigai Shokokukan ni Okeru Kenkyugijustusha Koryu* (The Interchange of Researchers and Engineers Between Japan and Other Countries) (Tokyo: NISTEP, 1991).

TABLE 3-3 Flow of Technology-Intensive Manufactured Products, 1992, million dollars

Product/SIC Code	U.S. Exports to Japan	U.S. Imports from Japan	Balance
Chemicals and allied/28	4,502	2,935	1,567
Electronic components and accessories/367	1,190	6,600	–5,410
Selected metalworking equipment/ 3541, 3542, 3544, 3546, 3548	233	1,851	–1,618
Selected electrical and renewable energy equipment/3612, 3613, 3621, 3625	132	1,253	–1,121
Aerospace/37A	4,442	593	3,849
Selected industrial and analytical instruments/3821, 3823, 3825, 3826, 3827	926	1,167	–241
Computers and peripherals/3571, 3572, 3575, 3577	3,308	11,226	–7,918
Telephone and telegraph apparatus/3661	312	1,665	–1,353
Search and navigation equipment/3812	296	106	190
Drugs/283	963	685	278
Medical instruments and supplies/384	988	1,023	–35
Motor vehicles and automotive parts/3711, 3715, 3465, 3592, 3647, 3691, 3694, 3714	1,900	33,100	–31,200
Total	19,192	62,204	–43,012

SOURCE: Compiled from U.S. Department of Commerce, *U.S. Industrial Outlook 1994* (Washington, D.C.: U.S. Government Printing Office, 1993).

TABLE 3-4 Stocks and Flows of Foreign Direct Investment and Cross-Border Research and Development, million dollars

	A Japanese Firms in United States	B U.S. Firms in Japan	A/B Japan-U.S. Ratio
Net flow of FDI, 1993	–1,324	4,803	N/A
Accumulated stock, year end 1993	96,213	31,393	3.1
Accumulated stock, manufacturing, year end 1993	17,746	13,610	1.3
R&D expenditures, 1992	1,642	658	2.5

NOTE: R&D expenditures includes those funded by affiliates.
SOURCES: U.S. Department of Commerce, *Survey of Current Business*, various issues and communications with the Bureau of Economic Analysis, April 1995.

The result of these long-standing funding, performance, and commercialization patterns is a system that encourages basic scientific discovery and the creation of new technology, which encourages open access to knowledge through support for nonproprietary performers of R&D (mainly universities) and where the focal application areas for technology policy have been mission oriented (mainly defense but also space, energy, and public health). U.S. primacy in technology and the ready availability of resources for technology development have meant that U.S. companies and other organizations have few incentives to seek out or apply technologies developed in other countries. Therefore, there is little corporate investment or public infrastructure for doing so. Opportunities for technology commercialization in the United States are so abundant and the pace of technology development is so rapid that established firms have often been unable to leverage their considerable organizational and resource advantages to capitalize on all of them, leaving ample room for entrepreneurs and new entrants.[4] The U.S. market for goods has generally been open during the postwar period, so Japanese and other foreign manufacturers have been able to gain access without transferring technology or making other trade-offs.

The contrast of the U.S. system with the structures and incentives that have traditionally operated in Japan could not be greater. In Japan the government funds only about one-fifth of R&D activities.[5] Table 3-5 shows U.S. and Japanese government R&D funding priorities. Since the time of the Meiji Restoration in the mid- to late-nineteenth century, Japan has seen technological capability as a key to economic development and national security. Government and industry have worked in a cooperative and complementary way to build mechanisms for acquiring foreign technology, capabilities for effectively utilizing it, and market incentives and management structures to indigenize and improve upon imported know-how.[6]

Prior to World War II the Japanese innovation system was largely oriented toward military and national security objectives. With defeat and occupation, national priorities as reflected in government policies and corporate strategies were reoriented to emphasize technology development for commercial industries. The focus on technology acquisition from abroad has been a consistent feature since the middle of the last century and has been facilitated during the postwar period by Japanese policies, corporate strategies, and resulting market structures that denied or brokered market access in order to promote indigenous industries and extract technologies from leading foreign companies.[7] Today, most formal barriers have been removed, but deep-rooted government and private practices in areas such as procurement, distribution, and regulation combined with the accumulated legacy of past discrimination against foreign products

[4]Particularly in the microelectronics and computer industries, this tendency was promoted by U.S. government policies that mandated licensing at reasonable terms of breakthrough technologies developed by several large U.S. companies. These policies, based on antitrust concerns, prevented these large companies from making full and exclusive use of their innovations.

[5]See Science and Technology Agency, *Indicators of Science and Technology 1994* (Tokyo: Okurasho Insatsukyoku, 1994), p. 25. About half the Japanese government total is accounted for by the Ministry of Education. It is also likely that salary accounting practices introduce an upward bias in the Ministry of Education figure, meaning that Japanese government R&D expenditures would be even lower if they were counted in the same way that they are in the United States.

[6]See Hiroyuki Odagiri and Akira Goto, "The Japanese System of Innovation: Past, Present and Future," in Nelson, op. cit., pp. 76-114.

[7]Understanding of these issues has improved recently as a result of heightened attention from Western scholars, including Mark Mason, *American Multinationals and Japan: The Political Economy of Japanese Capital Controls, 1899-1980* (Cambridge, Mass.: Harvard University Press, 1992).

TABLE 3-5 Distribution of Government R&D Budget Appropriations, by Socioeconomic Objective, 1992, percent

Objective	United States	Japan
Agriculture, forestry, and fishing	2.2	3.6
Industrial development	0.3	3.9
Energy	4.5	21.3
Infrastructure	2.2	1.9
Transportation and telecommunications	2.0	1.5
Urban and rural planning	0.2	0.3
Environmental protection	0.7	0.5
Health	14.7	0.5
Social development and services	1.3	2.9
Earth and atmosphere	1.2	1.0
Advancement of knowledge	3.9	50.8
Advancement of research	3.9	8.3
General university funds	[a]	42.5
Civil space	9.6	7.1
Defense	59.4	5.9
Total	100.0	100.0

[a] The United States does not have an equivalent to Japan's general university funds.

NOTE: Percentages may not add to 100 because of rounding. U.S. data are based on budget authority. Because of general university funds and slight differences in accounting practices, the distribution of government budgets among socioeconomic objectives may not completely reflect the actual distribution of government–funded research in particular objectives. Japanese data are based on science and technology budget data, which include items other than R&D. Such items are a small portion of the budget, and therefore the data may still be used as an approximate indicator of relative government emphasis on R&D by objective.

SOURCE: National Science Board, *Science and Engineering Indicators*, 1993.

and companies continue to result in a hostile market environment for foreign entrants in a range of high-technology markets.[8]

The technological capabilities of Japanese companies and industries were rapidly upgraded and supported by a complementary set of policies and institutions that encouraged high levels of capital equipment investment.[9] Japanese consumer electronics, automobiles, machine tools, semiconductors, and other products have gained first acceptance and then outstanding success in world markets. In 1992 Japan produced 28 percent of the high-technology products made in

[8]See U.S. Trade Representative, *1994 National Trade Estimate Report on Foreign Trade Barriers* (Washington, D.C.: U.S. Government Printing Office, 1994), pp. 141-184.

[9]There is evidence that Japanese companies have put relatively more emphasis on process as opposed to product R&D than U.S. companies do and that Japanese companies are faster at commercializing products based on external technology. See Edwin Mansfield, "Industrial Innovation in Japan and the United States," *Science*, September 30, 1988, pp. 1769-1774.

OECD countries, second only to the 37 percent share held by the United States.[10] Through its innovation and market systems, Japan has achieved a remarkable economic and technological miracle and serves as a model for other countries, particularly in Asia, seeking the rapid development of economic and technological strength.

When viewed from the point of view of the national goals that they have served, both the U.S. and Japanese innovation systems should be viewed as outstanding successes. However, it is clear that the wide differences in how technology development is organized, funded, and performed in the two countries have a profound impact on bilateral technology flows.[11] Without significant changes in either or both systems, these patterns may well persist. In both the United States and Japan there are debates and movement under way that may eventually result in change of the required magnitude, including recent technology policy initiatives in the United States, and perennial calls for greater university research funding in Japan. Even if significant changes in the policies of the two countries were to be implemented, it is possible that we would not see an impact on the U.S.-Japan science and technology relationship for some time.[12]

OVERVIEW OF U.S.-JAPAN DEFENSE INDUSTRIAL/TECHNOLOGY COOPERATION

Chapter 2 outlined the framework of the U.S.-Japan security alliance over the postwar period, as well as the basic motivations and trade-offs on each side in defense industrial and technological cooperation. This section will describe the evolution of U.S.-Japan cooperation in greater detail, placing it within the context of the relevant political and economic forces at work within each country and in U.S.-Japan relations.

The 1954 Mutual Defense Assistance Agreement serves as the basis for defense industrial cooperation.[13] During the latter half of the 1950s, Japan launched the licensed production of U.S. weapons systems, most notably the F-86 fighter aircraft, and also built up design capabilities with the independent development of a jet trainer. At first, a large percentage of Japan's defense production was financed by the United States, but this aid gradually declined and was phased out in the 1960s. By the early 1960s, defense production accounted for about a tenth of overall industrial production.[14]

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[10]National Science Board, *Science and Engineering Indicators 1993* (Washington, D.C.: U.S. Government Printing Office, 1993), p. 440.

[11]The predominant continuing pattern of technology transfer from the United States to Japan can also be seen at the sector and individual-firm levels. See Committee on Japan, *U.S.-Japan Strategic Alliances in the Semiconductor Industry: Technology Transfer, Competition, and Public Policy* (Washington, D.C.: National Academy Press, 1992); *U.S.-Japan Technology Linkages in Biotechnology: Challenges for the 1990s* (Washington, D.C.: National Academy Press, 1992); and *High-Stakes Aviation: U.S.-Japan Technology Linkages in Transport Aircraft* (Washington, D.C.: National Academy Press, 1994).

[12]In contrast to the science and technology relationship—narrowly defined as flows of licensing income and technical personnel—U.S.-Japan trade in high-technology products could be impacted if Japan implements significant market opening and deregulation policies. Recent progress can be seen in selected markets, such as personal computers.

[13]For the broader context of U.S. defense industrial cooperation with NATO allies, South Korea, and others, see U.S. Congress, Office of Technology Assessment, *Arming Our Allies: Cooperation and Competition in Defense Technology* (Washington, D.C.: U.S. Government Printing Office, 1990).

[14]Michael J. Green, *Japan's Search for Autonomous Defense Production 1945-1993: Arms, Technology and Alliance* (Ph.D. dissertation, 1993, forthcoming from Columbia University Press), p. 91.

First Printing, September 1992
Second Printing, October 1995

With the end of U.S. assistance, the Japanese government exercised greater autonomy over the defense budget. In 1967 it adopted the "three principles" restraining arms exports.[15] Momentum built throughout the late 1960s for higher Japanese defense budgets and a significant increase in indigenous weapons development and procurement. Indigenous projects launched during the late 1960s and early 1970s, such as the C-1 transport, the T-2 trainer, and the F-1 fighter, reflect this trend. However, movement toward a substantial, independent Japanese defense industrial and technology base stalled in the early 1970s owing to the shallow political support outside the circle of defense contractors, the military establishment, and the prodefense group of conservative politicians in light of the large budget increases that would be required. With the end of fixed exchange rates and the U.S. rapprochement with the People's Republic of China in 1971 (the so-called Nixon shocks), U.S. weapons became relatively less expensive and the Chinese military threat lost its force as a rationale for a significant Japanese defense buildup.[16]

From the late 1970s, the Japan Defense Agency shifted its R&D funding priorities to emphasize support for "spinning on" technologies from Japan's commercial sector. In addition to recognizing the growing importance of dual-use technologies in weapons development, this focus turned the budgetary limitation on large new indigenous systems into a virtue.[17] The spin on process in Japan, seen most frequently at the supplier tiers, typically involves the application of existing commercially-based capabilities to emerging weapons development opportunities. When Mitsubishi Electric began its research on active phased array radar in the late 1960s with partial support from JDA, it applied its commercial gallium arsenide integrated circuit know-how, eventually developing the radar for the FS-X years later.[18] The development of Japanese capabilities in superconductivity and composite materials has been characterized by a process of "interdiffusion," in which military-related R&D helped to leverage the work of key companies such as Mitsubishi Electric and Toray to create a broad business base for these technologies in commercial markets.[19]

The late 1970s also saw the genesis of several other significant shifts in the U.S.-Japan security relationship, prompted by changes in the international environment. The intensification of the Cold War after the Soviet invasion of Afghanistan led to increased U.S. interest in building up and integrating Japan's military capabilities into a more effective common defense structure in the Western Pacific. After some fits and starts on the Japanese side, closer coordination and increased Japanese procurement to support the defense of sea lanes around Japan and other missions were accomplished by the Reagan administration and the Nakasone cabinet.

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[15]A more detailed description of the "three principles" is given in Box 4-3. The impact of the three principles and Japan's export control policies on U.S.-Japan cooperation is considered in greater detail in other parts of this report. In the mid-1970s a new interpretation of the policy effectively banned all weapons and weapons technology exports, although a 1983 exchange of notes allows weapons technology transfers to the United States.

[16]See Green, op. cit., pp. 112-114.

[17]Incorporating commercial technologies into military systems is one of the two meanings of "dual-use" technology given in the introduction and is increasingly important for the United States as well. Because of the major focus of the United States on military technologies since World War II, the other context for dual-use, military technology "spinning off" to commercial uses, has been more relevant.

[18] Richard J. Samuels, *Rich Nation, Strong Army: National Security and the Technological Transformation of Japan* (Ithaca, N.Y.: Cornell University Press, 1994), p. 293.

[19] Ibid., pp. 293-294 and 304-306.

The second shift was the increasing interest shown by the U.S. Department of Defense in gaining access to Japanese technologies to meet American and common security needs. In 1980 the Systems and Technology Forum (S&TF) was established between the two countries to explore possible joint R&D projects in military technology. In 1983 the Japanese government announced that transfers of military technology to the United States, and only the United States, would be allowed as an exception to the "three principles" on arms exports. An exchange of notes between the two governments established the Joint Military Technology Commission (JMTC) and formal mechanisms for the transfer of Japanese military technology to the United States.[20] These new institutions have opened up possible new areas of cooperation, and the progress to date and future prospects are examined in more detail in Chapter 4. However, the S&TF and JMTC have not yet facilitated significant cooperation or transfers of technology to the United States.

Throughout the 1980s and up to the present, the predominant forms of U.S.-Japan defense industrial cooperation remain what they had been throughout the Cold War—Japanese licensed production of U.S. systems and off-the-shelf purchases of U.S. systems. Japanese licensed production of the F-15 fighter and Patriot missile and Japanese procurement of AWACS illustrate this pattern. The only departure has been the FS-X codevelopment, discussed more extensively in Chapter 4, which represented a compromise between Japan's desire to develop an indigenous fighter and the U.S. preference that Japan buy or license-produce a U.S. fighter.

In Japan the groups that have favored greater Japanese independence in developing and producing defense systems, allied in many cases with those that would use the defense budget to promote broader commercial technology goals, have had to contend with the fundamental political limitations on growth in the defense budget and with Japan's ultimate reliance on the security treaty with the United States. The interplay among Japan's political and economic interests has evolved and shifted over time, with tensions always inherent. During the 1950s and 1960s, arguments that greater capability in defense technology would give Japan more leverage in its relationship with the United States mostly prevailed. During the 1970s, the argument that minimal defense capability and greater reliance on the alliance with the United States would maximize Japan's freedom to act politically and economically in world affairs, particularly in Asia, came to prominence.

Despite constraints on defense budgets and military activities, Japan has built a small sophisticated defense industrial and technology base that is well integrated with its commercial technology and manufacturing capabilities, without the expensive overhead of a full-fledged military industrial complex comparable to that of the United States. Japanese government and industry have become quite skilled over the years in effectively utilizing scarce resources to sustain and enhance technological capabilities. This has been facilitated by the commercial technology orientation of Japanese defense contractors. For major Japanese weapons makers, defense contracts make up a relatively small share of their overall businesses, in contrast to most U.S. defense contractors. Table 3-6 lists major U.S. and Japanese defense contractors. Some of the grander visions for "spin-off" benefits—such as the 60-seat YS-11 commercial transport—

[20]U.S. Department of Defense, Office of the Under Secretary of Defense for Research and Engineering, *Japanese Military Technology: Procedures for Transfers to the United States*, February 1986.

TABLE 3-6 Top U.S. and Japanese Defense Firms, 1993, million dollars

	Defense Revenue	World Rank	Total Revenue	Percentage of Revenue in Defense	R&D[a] Expenditures	R&D as Percentage of Revenue
Top U.S. Defense Firms						
Lockheed Corp.	10,195	1	13,071	78.0	449	3.4
McDonnell Douglas Corp.	9,052	2	14,487	62.5	341	2.3
GM Hughes Electronics Corp.	6,600	3	13,500	48.9	612	4.5
Martin Marietta Corp.	6,320	4	9,435	67.0	280	3.0
Raytheon Corp.	4,700	6	9,200	51.1	279	3.0
Northrop Corp.	4,532	7	5,063	89.5	97	1.9
Boeing Co.	4,407	8	25,438	17.3	1,244	4.9
United Technologies Corp.	4,000	10	20,700	19.3	1,137	5.5
Loral Corp.	3,608	12	4,009	90.0	125	3.1
Top Japanese Defense Firms						
Mitsubishi Heavy Industries	2,372	21	24,931	9.5	992	4.0
Kawasaki Heavy Industries	1,120	38	8,556	13.1	195	2.3
Ishikawajima-Harima Heavy Industries	840	47	7,726	10.9	318	4.1
Mitsubishi Electric Corp.	820	49	27,806	2.9	1,542	5.5
Itochu Corp.	475	69	149,914	0.3	n/a	n/a
NEC Corp.	390	79	32,053	1.2	2,627	8.2
Toshiba Corp.	353	86	41,466	0.9	2,288	5.5
Mitsui Engineering and Shipbuilding Co.	306	92	3,111	9.8	59	1.9
Fuji Heavy Industries	276	100	9,095	3.0	212	2.3

[a] Japanese figures converted at ¥118 per dollar (March 1993).
SOURCES: *Defense News*, July 18-24, 1994; *Japan Company Handbook: First Section*, Toyo Keizai, Summer 1993; U.S. firm annual reports.

were not successful. But over the longer term Japan has been quite successful in leveraging the technological and manufacturing base benefits of licensed production, supplemented by indigenous defense programs, to establish a significant foothold in commercial aircraft production.

Through most of the postwar period, an important goal for U.S. policy was to increase Japanese defense capabilities to the extent possible within the political limitations of public opinion and the "Peace Constitution." The United States also sought to discourage Japanese deployment of systems that could be destabilizing in the Asian regional environment (such as aircraft carriers). But defense industrial cooperation with Japan was not a major concern for the United States through much of this period. Only in the 1980s did Japan's strides in industrial technology prompt the Department of Defense to begin thinking in terms of acquiring technology from Japan and only with the FS-X did concerns over the broader industrial and commercial

impacts of U.S. military technology transfers to Japan come to the forefront. Tables 3-7 and 3-8 illustrate Japanese technological strengths in areas critical for future defense systems, mainly areas of commercial technology that are increasingly incorporated into these systems.

TABLE 3–7 U.S. Department of Defense Key Technologies and Areas of Japanese Technical Strength

Key Technologies and Subareas	*Broad Technical Achievement*	*Moderate Technical Capability*
Computers (overall)		x
Specialized computing systems		x
Optical processing		x
Software (overall)		x
Software and systems engineering	x	
Human-computer interaction		x
Artificial Intelligence		x
Software for parallel and heterogeneous systems		x
Sensors (overall)		x
Radar sensor technology	x	
Electro-optic sensor technology		x
Multisensor integration		x
Communications networking (overall)		x
Network management and capacity utilization subsystem	x	
Data retrieval and information production system		x
Electronic devices (overall)		x
Microelectronics	x	
Radio frequency components		x
Electro-optics		x
Environmental effects		x
Environmental sensing		x
Environmental characterization and prediction		x
Science generation and environmental decision aids		x
Materials and processes (overall)		x
Structural materials, processing and inspection		x
Electronic, magnetic and optical materials	x	
Special function and biomolecular materials and processes		x
Energy storage (overall)		
Power sources		x
Propulsion and energy conversion (overall)		x
Missile, space, and aerospace vehicle propulsion		x
Design automation (overall)		x
Product and process definition		x
Information flow and integration		x
Human-system interfaces		
Information management		x

SOURCE: Compiled from U.S. Department of Defense, *Key Technologies Plan*, 1992.

The context has changed dramatically in recent years. Table 3-9 shows defense budget and defense R&D trends in the United States and Japan. Flat and declining budgets have prompted different reactions in the two countries. In the United States the major trend has been consolidation, with defense companies merging, selling, and acquiring businesses. Particularly for the major contractors, there is a smaller number of larger companies than there was several years ago. Japan's defense budget has been flat in recent years, and, as Table 3-10 shows, overall aircraft production has declined as well. Although the recently announced plan of Ishikawajima-Harima Heavy Industries (IHI) and Sumitomo Heavy Industries to merge the marketing and R&D functions of their defense shipbuilding operations is seen by some as a harbinger of extensive consolidation, Japanese defense industry restructuring is likely to take a very different form from that of the U.S. and European industries, with fewer moves toward consolidation or outright exits from the business.[21] Concerns have been expressed in Japan about companies cutting defense R&D and moving their most talented engineers out of defense businesses.

While it would seem that the trends toward lower defense budgets, greater utilization of commercial technologies, and Japan's greater relative strength in these areas would provide a favorable environment for expanded reciprocal U.S.-Japan cooperation, this has not materialized and will likely prove difficult to bring about. The controversy surrounding the FS-X negotiations

TABLE 3-8 U.S. Department of Defense Key Technologies and Areas of Foreign Strength

	NATO Allies	Japan	CIS	Others
Overall areas of broad technical achievement	0	0	0	0
Subareas of broad technical achievement	4	6	4	0
Overall areas of moderate technical capability	10	9	6	0
Subareas of moderate technical capability	31	22	14	2

NOTE: A total of 11 overall areas and 41 subareas were evaluated.
SOURCE: Compiled from U.S. Department of Defense, *Key Technologies Plan*, 1992.

[21] Hisayuki Mitsusada, "Major Shipbuilders Merge Defense-Contract Operations," *The Nikkei Weekly*, May 1, 1995, p. 1. IHI and Sumitomo Heavy will maintain their separate production facilities. In the United States or Europe, a comparable restructuring would almost certainly involve the outright purchase by one company of the other's shipbuilding operations.

TABLE 3-9 Defense and Defense R&D Spending in the United States and Japan, billion dollars

	1989	1990	1991	1992	1993
United States					
Total defense budget	299.5	303.3	288.9	282.1	267.1
Defense spending (as a percentage of GDP)	5.9	5.5	4.8	5.0	4.6
Defense R&D budget	37.5	36.4	36.2	36.6	37.7
Defense R&D (as a percentage of defense budget)	12.5	12.0	12.5	12.9	14.1
Defense R&D (as a percentage of total government R&D spending)	66.4	64.3	60.0	58.9	59.0
Japan					
Total defense budget	35.6	37.8	39.8	41.3	42.1
Defense spending (as a percentage of GNP)	1.01	0.99	0.95	0.94	0.94
Defense R&D budget	0.75	0.84	0.93	1.04	1.12
Defense R&D (as a percentage of defense budget)	2.1	2.2	2.3	2.5	2.7
Defense R&D (as a percentage of total government R&D spending)	4.2	4.4	4.5	4.7	

NOTES: All figures reflect government outlays; conversions at ¥100 per dollar. Japanese companies have traditionally funded a larger portion of early-stage defense R&D than U.S. firms. This corporate funding is not reflected in these figures.

SOURCES: Office of Management and Budget, *Budget of the United States Government—Historical Tables, 1995*; Japan Science and Technology Agency, *Indicators of Science and Technology, 1994*; Michael Chinworth, *Inside Japan's Defense*, 1992; Japan Defense Agency, *1993 Defense White Paper*; National Science Board, *Science and Engineering Indicators, 1993.*

TABLE 3-10 Japanese Aircraft Production Trends, million dollars

	1992	1993	Percent change	Forecast 1994	Percent change
Production	8,423	8,001	(–5%)	7,609	(–5%)
Exports	1,416	1,035	(–27%)	1,001	(–3)
Orders	7,892	8,020	(2%)	6,879	(–14%)

NOTE: Currency conversion at ¥100 per dollar.

SOURCE: Nihon Koku Uchu Kogyokai (Society of Japanese Aerospace Companies), *Kokuki Kanren Seisankaku Nado no Mitoshi ni Tsuite* (Update on Aircraft-Related Production), August 1994.

illustrated the pressures on each country mitigating against a continuation of the traditional asymmetrical patterns in the relationship. Leaders in both the United States and Japan are well aware of the value of continued and expanded cooperation in security affairs, economics, and science and technology, but governmental institutions and private incentives reflect and help perpetuate long standing asymmetries. Table 3-11 shows that a few Japanese defense technologies have been transferred to the United States since the 1983 exchange of notes. However, these very limited transfers have not resulted in a measurable contribution to U.S. defense capabilities.[22]

TABLE 3-11 Japanese Military Technologies Transferred to the United States Since 1983[a]

	Year	Japanese Company
Technology for the construction and remodeling of U.S. naval systems	1986	Ishikawajima-Harima Heavy Industries
Technology related to the next-generation support fighter (FS-X)	1990	Mitsubishi Heavy Industries
Technology related to joint research on ducted rocket engines	1992	Nissan Motor

[a] Transfers of Japanese technology related to portable surface-to air missiles (Toshiba) and for the digital flight control system on the P-3C antisubmarine patrol aircraft (Kawasaki Heavy Industries) were also approved but never carried out.

SOURCES: Japan Defense Agency, *Defense of Japan 1994* (Tokyo: Japan Times, 1994), p. 74, and *Nihon Keizai Shimbun*, November 29, 1994.

[22] For a discussion of several of the early transfers, see Steven K. Vogel, *Japanese High Technology, Politics and Power—Research Paper #2* (Berkeley: Berkeley Roundtable on the International Economy, 1989), pp. 36-41.

4
Motivations and Mechanisms for Cooperation in Defense Technology

SUMMARY POINTS

- *Historically, Japanese licensed production of U.S. systems has evolved as the most common mechanism for U.S.-Japan defense technology collaboration because it represents a compromise between the Japanese preference for indigenous production and the U.S. preference for off-the-shelf sales.*
- *Because of growing concerns in the United States over imbalanced flows of technology and the risk of enabling Japanese competition in commercial industries, reliance on licensed production has become increasingly problematic in recent years.*
- *Other mechanisms have been pursued, such as integrating Japanese subsystems into systems sold to Japan by the United States, codevelopment, and small-scale collaborative research and development (R&D). Each of these mechanisms could deliver benefits to the United States, but each also involves barriers and potential pitfalls.*

The United States and Japan have cooperated in defense technology and defense industrial areas for roughly 40 years. This chapter describes the mechanisms for U.S.-Japan cooperation in defense technology that have been important in the past as well as newer approaches with a focus on the motivations and impacts on the U.S. and Japanese sides. The major mechanism for collaboration is still Japanese licensed production of U.S. systems. Table 4-1 shows that Japan continues to be a large market for U.S. weapons, and that licensing fees constitute a large part of the total flow of income from Japan.

TABLE 4-1 Japan Defense Agency Overseas Procurement, current million dollars

	From the United States					
Year	Foreign Military Sales	Direct Commercial Sales	Licensing Fees	Total	From Other Countries	U.S. Share, %
1990	643	313	1,556	2,512	54	98
1991	890	488	1,206	2,584	84	97
1992	755	472	1,027	2,254	54	98

SOURCE: Mutual Defense Assistance Office, Tokyo, Japan.

POSSIBLE U.S. BENEFITS

From the U.S. perspective, benefits from technological collaboration with Japan in the context of the defense relationship could come in a number of forms, as described below.

"Hard" Technology

This category of benefits can be defined as specific product or process knowledge that can be transferred in a straightforward way, mainly through data exchange. Hard technology is generally proprietary in nature, with transfer occurring through licensing or cross-licensing. Most of the defense technology that the United States has transferred to Japan through licensed production of U.S. systems and other mechanisms is of this type. In the case of the FS-X codevelopment, Japan was provided with about 95 percent of the 10,550-document F-16 technical data package.[1] The "flowback" of Japanese improvements made to U.S.-derived technologies is written into government-to-government and many industry-to-industry agreements. For example, Mitsubishi Heavy Industries has transferred data on the FS-X composite wing to Lockheed Martin as flowback. To transfer hard technology effectively, exchanges of technical personnel and other forms of instruction are often required to supplement exchanges of data or drawings.

"Soft" Technology

This term describes knowledge that can be applied in improving quality or productivity but is not specific to particular products or processes. Soft technology includes techniques and practices for managing manufacturing systems and product development processes, which are developed over time in organizations (so-called tacit knowledge). In many cases, soft technology can be described, transferred, or adapted, given a favorable organizational context. One of the best-known examples of soft technology originating in Japan is the Toyota Production System, the set of practices for managing manufacturing.[2] Although the transfer of such knowledge is facilitated by direct experience, soft technology of widespread significance tends to quickly become a public good.[3]

Leverage for Scarce Resources

Collaboration with Japan in defense-related R&D or production could leverage U.S. government or industry resources. For example, collaborative R&D in technical areas of mutual interest might facilitate access to a given scale of R&D effort at reduced cost. Codevelopment of systems or subsystems could leverage government budgets and industry engineering efforts. Licensing income from production of U.S. systems in Japan can be reinvested in developing more advanced technologies.

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[1]U.S. Congress, General Accounting Office, *U.S.-Japan Codevelopment: Update of the FS-X Program* (Washington, D.C.: U.S. Government Printing Office, June 1992), p. 5.

[2]See Toyota Motor Corporation, *The Toyota Production System* (Toyota City, Japan: Toyota Motor Corp., 1992). The Toyota Production System, or TPS, is also known as "lean manufacturing."

[3]A growing number of U.S. manufacturers are adapting Japanese management practices in manufacturing and product development. See Rajan R. Kamath and Jeffrey K. Liker, "A Second Look at Japanese Product Development," *Harvard Business Review*, November-December, 1994, pp. 154-170.

Influence and Goodwill

Through the range of interactions and relationships surrounding the security alliance, including collaboration in defense technology, the United States is able to influence aspects of Japanese defense and foreign policies, such as the choice of defense systems. Deployment of common or interoperable systems enhances the effectiveness of joint operations. Technology collaboration might also play a role in enhancing goodwill between the defense establishments and broader publics of the two countries.

MECHANISMS FOR COOPERATION

Japanese Procurement of U.S. Systems: "Off-the-Shelf" and "Blended" Modes

While this form of U.S.-Japan interaction by definition does not involve extensive technology transfer in the traditional sense, it serves as a useful baseline to begin evaluating the motivations and benefits on each side for various forms of interaction and emerging trends. Historically, defense technology transfers from the United States to Japan have occurred in the context of Japanese procurement. As Japan considers a given weapons system, purchase from the United States or other supplier countries represents one option along a continuum that may include licensed production, codevelopment, and indigenous development.

In the case of many off-the-shelf sales, money is simply paid for a given system, with very little technical activity associated with the exchange.[4] The benefits to the United States from this arrangement come in several forms. First, the procurement allows Japan to contribute more to its own defense through increased capability. Second, a purchase of U.S. equipment ensures interoperability with the equipment used by U.S. troops already based in Japan as well as those likely to be deployed in the theater during a contingency. Third, the United States avoids several risks sometimes associated with technology transfer through licensed production, including proliferation to hostile countries, future Japanese development of indigenous systems based on the transferred technology, and utilization of transferred technology to compete with U.S. companies in commercial markets. Fourth, the proceeds from weapons sales to Japan help to maintain the U.S. defense technology and manufacturing base.

Traditionally, Japan has preferred licensed production and indigenous development—procurement mechanisms that its domestic industry can utilize to either obtain U.S. technology or develop indigenous capability—to purchases.[5] With downward pressure on the Japanese defense budget and the growing cost advantage of U.S.-produced weapons as a result of the recent yen appreciation, there would appear to be added incentive for Japan to increase purchases of U.S. equipment relative to more expensive licensing and indigenous development options. However, Japanese defense contractors and their allies can also be expected to fight hard to retain as much domestic development and manufacturing as possible. In recent years, AWACS

[4]Soft technology in the form of knowledge necessary to operate the system effectively is transferred. Japan and other countries purchasing U.S. systems are also generally able to buy upgraded versions of the systems.

[5]In addition to gaining technological and manufacturing base benefits, Japan's rationale for licensed production or indigenous development has often involved complaints about the high cost of U.S. systems and poor service. See Michael Chinworth, *Inside Japan's Defense* (Washington, D.C.: Brassey's (US), Inc., 1992)., pp. 124-126.

(airborne warning and control system) and other large off-the-shelf purchases have raised concerns in Japan's defense industry.[6]

For the most complex defense systems, or so-called systems of systems, the distinctions between purchases and other forms of collaboration such as licensed production and codevelopment can blur. One recent example is the Japanese procurement of Aegis destroyers.[7] The overall battle management system was sold to Japan through the Department of Defense's (DoD) foreign military sales (FMS) program, so technology transfer in the traditional sense was limited. However, Japan's Aegis procurement has involved extensive U.S.-Japan technical and engineering interaction because the destroyer hulls and several of the individual weapons systems are designed and manufactured in Japan. The integration of Japanese elements into the U.S.-developed system required the creation of new interfaces to maintain the real-time information management critical to the system's operation.

The Aegis experience is relevant to future U.S.-Japan cooperation because several of the capabilities that Japan is considering for the future, such as theater missile defense and reconnaissance satellites, have a "system of systems" character and could potentially involve a blending of components developed and produced by the United States, Japan, or both countries. Particularly in cases where one-way technology transfer is not extensive, with this type of "blended" interaction in which U.S. and Japanese technological and engineering contributions are combined within the overall framework of a Japanese purchase of a U.S. system, both countries can achieve clear benefits.

Several factors contributed to success in the Aegis case. To begin with, there was widespread support in Japan for the top-level decision to deploy the system. Aegis allows Japan to fulfill operational roles within the framework of the U.S.-Japan alliance that had been committed to in the early 1980s.[8] Building the hulls in Japan and utilizing several Japanese weapons systems—combined with the fact that indigenous development of the entire system was not a realistic option—solidified this support in Japanese industry and government. Also, the U.S. Navy and U.S. contractors had accumulated valuable experience from managing the complex U.S. program for a number of years and were able to effectively apply this experience in working with their Japanese counterparts. It is important to note that several of the political and management factors that contributed to the success of Aegis might not be present in potential areas of future U.S.-Japan collaboration, such as theater missile defense (see Box 4-1 and Appendix D).

In the case of Aegis, the benefits to the United States were not technological—Japan's deployment of the system constitutes an enhanced contribution to the alliance, the income from the sale strengthens the U.S. defense industrial base, and the outward flow of technology was limited compared to licensed production. In the future the challenge will be to structure such programs so that they do facilitate technology transfer to the United States.

While the main obstacle to sales of U.S. systems is Japan's reluctance—shared by many other countries—to avoid large foreign arms purchases that do not involve significant Japanese production, development, or learning opportunities, there are other potential obstacles. In some cases, parties on either side may prefer to structure the procurement as a direct commercial sale

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[6]National Research Council, Committee on Japan, *High-Stakes Aviation* (Washington, D.C.: National Academy Press, 1994), p. 29.

[7]See Appendix E.

[8]See U.S. Congress, Office of Technology Assessment, *Arming Our Allies: Cooperation and Competition in Defense Technology* (Washington, D.C.: U.S. Government Printing Office, 1990), pp. 109-110.

Box 4-1 Navy International Programs Office

A number of U.S. government organizations have responsibility for aspects of international defense industry cooperation.[1] In addition to DoD organizations such as the Defense Security Assistance Agency, the Defense Technology Security Administration, and the Office of the Under Secretary of Defense for Acquisition, the military services play a role as well. The U.S. Navy's International Programs Office (IPO) deals with a variety of issues associated with the sale of naval weapons systems and the transfer of related technologies. IPO's areas of responsibility include export license review, foreign military sales (FMS), coproduction and cooperative development programs, arms control treaty compliance and verification, and advising U.S. defense industries on international marketing. The U.S. Army's equivalent of IPO is the Security Affairs Command, while the Air Force counterpart is the International Affairs Division of the Office of the Secretary of the Air Force.

A wide range of sophisticated naval weapons systems and technologies have been transferred to Japan through commercial sales, foreign military sales, and coproduction agreements. Representative commercial sales include MH-53 and SH-3 helicopters, LM2500 gas turbine engines, and Landing Craft Air Cushion vehicles. FMS sales have included Aegis integrated combat systems, Harpoon antiship and Standard antiaircraft missiles, vertical launch systems, E-2C Early Warning Aircraft, and UYK-43B and -44 computers. In addition, Japan has been permitted to coproduce Mk 46 torpedoes, SH-60/UH-60 helicopters, P-3C Orion antisubmarine aircraft, and Seasparrow and Sidewinder missiles. Finally, the United States and Japan have entered into a cooperative program to develop advanced steel technology under the rubric of the Systems and Technology Forum.

Naval commercial programs with Japan (including sales, coproduction, and licensing) have brought in approximately $400 million annually in recent years. Navy FMS programs have amounted to $800 million annually, or about half the total annual FMS to Japan recently.

[1]For a useful overview, see "Appendix VII, Organizing the Defense Department for International Defense Industry Collaboration," in Defense Science Board, *Defense Industrial Cooperation with Pacific Rim Nations* (Washington, D.C.: U.S. Department of Defense, 1989), pp. A7i–iv.

from the U.S. manufacturer, rather than going through the FMS program. For a direct commercial sale, the U.S. contractor obtains an export license from the Department of State, which consults with the DoD's Defense Technology Security Agency. In the case of FMS, DoD essentially purchases the system from the U.S. manufacturer and sells it to the foreign government.[9]

[9]For a general description of FMS and direct commercial sales procedures and issues, see U.S. Congress, Office of Technology Assessment, *Global Arms Trade: Commerce in Advanced Military Technology and Weapons* (Washington, D.C.: U.S. Government Printing Office, 1991), pp. 56-61. In the case of Japan, resistance to FMS often reflects the preference for licensed production mentioned above. For example, recent MIT Japan Program surveys found that both U.S. and Japanese industry respondents advocate greater DoD flexibility in allowing systems to be licensed produced rather than sold through FMS. See Michael Green, *The Japanese Defense Industry's Views of U.S.-Japan Collaboration: Findings of the MIT Japan Program Survey*, 1994, and Matthew Rubiner, *U.S.*

Japanese Licensed Production of U.S. Systems

This has been a common form of U.S.-Japan interaction over the past 40 years. Japan has produced many U.S. aircraft, missiles, and other weapons systems under license.

Some of the benefits that have traditionally accrued to the United States from Japan's licensed production of U.S. weapons systems are comparable to the benefits from a purchase—expanded Japanese capability, income for U.S. manufacturers (albeit without manufacturing base benefits of U.S. production), interoperability, influence, and goodwill.[10] The United States might also benefit from the flowback of Japanese improvements derived from licensed technology.[11] However, licensed production involves several risks for the United States that do not arise in sales of equipment.

First, there are traditional security and proliferation concerns—that U.S. weapons technology licensed to Japan might leak to third countries that could utilize it contrary to U.S. interests. There have been cases over the years of Japanese companies violating export controls, including the recent notable case of Japan Aviation Electronics selling missile parts, including parts made under U.S. license, to Iran.[12] Although such cases are disturbing, it does not appear that they are widespread.

Another risk is that Japanese licensees may use the expertise and manufacturing base established through licensed production to develop indigenous systems and subsystems, displacing U.S. companies in later procurements. A 1992 General Accounting Office report documents that Japanese firms cited their experience in F-15 licensed production to demonstrate their capability to supply the FS-X program.[13] The down side of this market risk has been experienced by U.S. firms but has been largely limited to the Japanese defense market to date because of Japan's proscription of arms exports.[14] This could change if the arms export ban is lifted in the future. In several areas of defense systems, notably aircraft and missiles, Japan has pursued a strategy of moving from purchasing U.S. systems to licensed production to indigenous development.[15]

A final risk of licensed production, from the U.S. standpoint, is that the technology and expertise transferred to Japanese companies will be utilized to compete with U.S. companies in nondefense areas. The long-term impact of the flow of U.S. technologies accompanying Japanese licensed production has been a topic of interest, concern, and debate for some time, with aircraft

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Industry and Government Views on Defense Technology Cooperation with Japan: Findings of the MIT Japan Program Survey, 1994.

[10]There are, however, doubts about the degree of interoperability that can be maintained in a licensed production program. This is particularly true in the case of a complex system, such as the F-15, in which Japan produces replacement parts and may not incorporate all the engineering changes that have occurred over the course of the U.S. program. See Chinworth, op. cit., pp. 129-131.

[11]A number of U.S. companies involved in defense technology cooperation with Japan report that flowback occurs regularly, but most do not consider it a major motivation for cooperating. See Rubiner, op. cit., p. 14.

[12]See Jeff Shear, *The Keys to the Kingdom: The FS-X Deal and the Selling of America's Future to Japan* (New York: Doubleday, 1994), p. 282.

[13]U.S. Congress, General Accounting Office, *Japanese Firms Involved in F-15 Coproduction and Civil Aircraft Programs* (Washington, D.C.: U.S. Government Printing Office, 1992), p. 10.

[14]For several examples, see Chinworth, op. cit., pp. 120-124.

[15]The technological capabilities of Japan's defense industry are more impressive in areas where commercial capabilities have been brought to bear and are generally lagging or uneven in the most specialized, advanced defense equipment. See Arthur Alexander, *Of Tanks and Toyotas: An Assessment of Japan's Defense Industry* (Santa Monica, Calif.: RAND Corp., 1993).

being a particular focus.[16] Drawing on the work of the individual scholars and groups that have examined the historical context and trends, it is possible to draw several lessons from the experience of Japanese licensed production that can be applied to future U.S.-Japan collaboration.

An important distinction to make in evaluating the impacts of licensed production on Japan's aircraft-related technological and industrial capabilities is between the benefits that are clearly technological and those that accrue from the manufacturing opportunities afforded by licensed production itself.

The manufacturing base benefits of licensed production for Japan's military and commercial aircraft capabilities have been and still are extremely critical. Licensed production of U.S. military aircraft has served as a foundation for the development of the Japanese aircraft industry. This activity sustained the growth of the industry through the 1960s and 1970s, when the only commercial aircraft activities were the ill-fated YS-11 and some minor subcontracting. The biggest benefit to Japan's aircraft industry, therefore, has been licensed production's crucial role in building and sustaining the engineering and manufacturing base of the heavy industrial manufacturers that serve as prime contractors for most Japanese aircraft programs and the entire supplier infrastructure. Licensed production has also benefited sectors other than aircraft. Licensed production and Japan's own indigenous weapons and technology programs have also delivered significant benefits for Japan's machinery industries and overall manufacturing and technology base, particularly in the 1950s and 1960s when defense products accounted for a significant share of total manufacturing activity.[17]

Purely technological contributions to Japan's capabilities in military aircraft have been important but have not yet propelled Japan into the "big leagues" of the global aerospace industry. Japan has independently developed a series of trainers and day-fighters. These have performed well, and the experience from licensed production must have been a help. But these aircraft have not exhibited cutting-edge design and integration capabilities. In the view of some experts, the experience of the FS-X program, discussed in more detail below, indicates that Japanese industry still had not acquired these skills by the late 1980s.[18]

In several specific areas the technological benefits of military licensed production programs for Japan's commercial aircraft industry are clear and compelling. This is particularly true for engines and some subsystems. Ishikawajima-Harima Heavy Industries first made long shafts in F100 licensed production and now dominates the worldwide commercial market for this component.[19] Blade casting is another example of a jet engine technology that was transferred through licensed production and is now utilized in commercial products.[20] The General

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[16]Among the sources that cover the topic are G. R. Hall and R. E. Johnson, "Transfers of United States Aerospace Technology to Japan," in R. Vernon, ed., *The Technology Factor in International Trade* (New York: National Bureau of Economic Research, 1970); U.S. Congress, General Accounting Office, *U.S. Military Coproduction Programs Assist Japan in Developing Its Civil Aircraft Industry* (Washington, D.C.: U.S. Government Printing Office, 1982); Michael Chinworth, *Inside Japan's Defense* (Washington, D.C.: Brassey's (US), Inc., 1992); Richard J. Samuels, *Rich Nation, Strong Army: National Security and the Technological Transformation of Japan* (Ithaca, N.Y.: Cornell University Press, 1994); and National Research Council, *High-Stakes Aviation, op. cit.*

[17]Samuels, op. cit., particularly Chapter 6.

[18]National Research Council, *High Stakes Aviation*, op. cit., p. 45.

[19]Ibid., p. 138.

[20]There are also examples of aircraft technologies in which U.S. restrictions on technology transfer provided impetus for Japanese companies, sometimes in conjunction with the Japan Defense Agency, to develop indigenous

Accounting Office report cited above also found that several Japanese suppliers participating in the F-15 program supply similar components in Boeing commercial programs.[21]

Japan has utilized licensed production of U.S. weapons systems to build and sustain industrial and technological capabilities that can be applied in both military and commercial production, a strategy that has been relatively successful.[22] However, it is notable that the basic technology in other specific commercial aircraft component areas where Japanese companies are very competitive today—fuselage panels, composite materials, and flat panel displays—did not come through military licensed production. Existing Japanese capabilities—some developed in other industries—were enhanced and developed primarily through links with U.S. commercial aircraft manufacturers. Still, military production affords Japanese industry opportunities to further refine technologies, and to apply these refinements to civilian markets. One recent example is the multifunction display that Yokogawa Electric developed for the FS-X. Yokogawa reportedly plans to apply the technology to civilian markets.[23]

Figure 4-1 shows the traditional preferences of Japan and the United States toward various collaborative mechanisms and illustrates why licensed production has often been utilized as a compromise between U.S. and Japanese preferences. The key questions for the future are how U.S. and Japanese objectives are likely to mesh and the implications of trends in both countries for U.S. strategy making toward licensed production. As has been pointed out, the United States may no longer have a compelling interest in a rapidly growing Japanese military capability. Therefore, the U.S. government's incentive to use licensing as an inducement for Japanese procurement of a given system might be expected to diminish. On the other hand, U.S. defense companies might have greater incentive to license systems to Japan as the U.S. defense budget remains lean.[24]

DoD's Technology-for-Technology (TFT) initiative implies that traditional licensing deals in which technology flows only to Japan may no longer be acceptable. Economic security and technology reciprocity concerns could constitute an obstacle on the U.S. side to cooperation in the future, particularly if these concerns are not taken into account in U.S. planning. An interagency process to assess the impacts of major defense technology transfers was stipulated in the Defense Authorization Act of 1989, but in the first major test, the FS-X (see Box 4-2), conflicts between various U.S. interests were not resolved in an effective way, leading to a contentious process. DoD has recently implemented organizational changes to ensure adequate consideration and consultation, but these new arrangements have not yet been tested in a major U.S.-Japan program.[25]

Japan must balance competing interests as well. As has been noted, it has pursued a strategy of producing and developing indigenously where possible, even if domestic weapons cost more and do not perform as well as imported systems. Barring a major shift in the external

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capabilities. In many cases these capabilities represented improvements on technologies transferred by the United States in earlier programs. See Michael Chinworth, *Inside Japan's Defense*, op. cit., especially Chapters 4 and 5.

[21]U.S. Congress, General Accounting Office, op. cit., p. 10.

[22]This is covered in great detail in Samuels, op. cit.

[23] "Minsei Bunya ne Tenyo," (Applying to Civilian Sector), *Nihon Keizai Shimbun,* June 19, 1995, p. 13.

[24]See Michael Green, *The Japanese Defense Industry's Views of U.S.-Japan Defense Technology Collaboration: Findings of the MIT Japan Program Survey*, op. cit., and Rubiner, op. cit.

[25]See "Industrial Capabilities for Defense," in *Department of Defense, Director, Defense Research and Engineering, Defense Science and Technology Strategy* (Washington, D.C.: U.S. Government Printing Office, 1994), pp. 12-16.

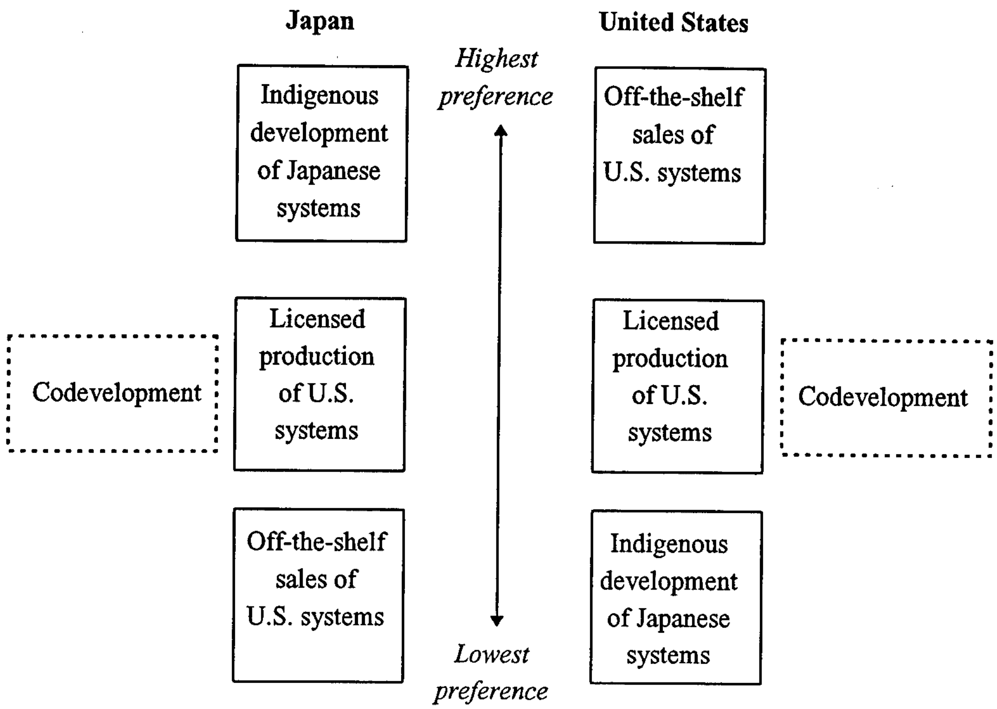

FIGURE 4-1 Traditional U.S. and Japanese preferences for interactive mechanisms.
SOURCE: National Research Council Defense Task Force.

environment, it will be more difficult to pursue this strategy in the future. There will be continuing pressure on the defense budget no matter how the current political turmoil plays out. These pressures will likely be intensified by Japanese defense budget practices which have delayed payments for current procurements and left major obligations to arms makers for the out years.[26] Japan is currently developing a number of indigenous systems for which there are existing U.S. substitutes. Licensed production costs more than purchasing from abroad but could maintain the manufacturing base at a lower cost than indigenous development.

One area where these trends might have important future implications is fighter aircraft. Japan is nearing completion of FS-X development, with test flights scheduled to begin in autumn 1995. The major decisions on the number of planes that will be built, or even whether the FS-X will enter production, were under discussion at the time of this writing. In recent years Japan has had an indigenous aircraft development project of some sort ongoing at all times in order to maintain its base of engineers and designers. These indigenous military aircraft projects included the F-1 fighter, the C-1 transport, and the T-2 and T-4 trainers. Now under discussion are plans to develop a technology demonstration fighter to occupy engineers after the end of FS-X development.[27] Currently, the licensed production of the F-15 is the mainstay of the Air Self-Defense Force, and procurement of the FS-X would supplement that.

[26]See Chinworth, op. cit., pp. 50-55.

[27]"Yuranki o Dasshita Jieitai" (Self-Defense Forces Pass Through Period of Uncertainty), *Nikkei Business*, October 31, 1994, pp. 38-40.

Beyond the next few years, however, the concrete demand for fighter aircraft in Japan is unclear. In the United States the F-22 is now entering production, but projected procurement has been cut with the end of the Cold War. A slowdown in the pace of global technological development in fighters means that from a purely military standpoint the rationale for more capable Japanese fighters is hard to make. It might be some time before Japan is opposed by a country with fighters as capable as the F-15.

The plan to develop a technology demonstration fighter can give Japan flexibility in this uncertain environment. If nothing else, the program will maintain the technology base of skilled engineering and design know-how. Japan's military needs may be adequately met for the foreseeable future by F-15s, T-4s and possibly FS-Xs, in which case the technology demonstrator might not be followed up by an indigenous development or licensed production program. In addition, just as the Japan Defense Agency's (JDA) Technical Research and Development Institute (TRDI) focused on R&D programs in the late 1970s and early 1980s aimed at technologies that the United States did not release to Japan—the so-called black boxes—in the F-15 licensed production program, the technology demonstrator could be aimed at achieving greater bargaining power if licensed production of the F-22 is judged to be desirable down the line.[28] The project also keeps the option of indigenous development open. Finally, some of the technologies reportedly targeted for the demonstrator—such as fly-by-light actuation—are relevant to future commercial aircraft programs.[29] Japanese aircraft makers and government officials are still considering the development of a 100-seat commercial transport in cooperation with foreign companies.[30]

The plans for a technology demonstrator indicate that despite the current budget situation and uncertain security environment Japan is determined to maintain its skill and technology base in fighter aircraft, which has allowed it to effectively produce advanced foreign designs and to indigenously develop less capable aircraft. It is possible that Japan, which has tried where possible to build technological capabilities across a range of weapons systems, will in the future narrow the focus and continue to combine indigenous development and assimilation of U.S. technology as appropriate. It is likely that some of the many indigenous projects that are being investigated and developed will be dropped. Whether Japan opts for licensed production, seeks codevelopment, or purchases foreign systems to fulfill some of those plans is uncertain.

Two general approaches are possible. Japan could continue the course of spending more on defense R&D, including technology development and prototyping, in an environment of flat or declining overall procurement. In this case, procurement might focus on spending more to bring key indigenous programs into production, while fulfilling other needs through purchases from the United States and perhaps other overseas suppliers. This would imply less licensed production activity than is currently taking place. A second possibility is a greater emphasis on maintaining the defense manufacturing base, which could imply a move away from indigenous systems to greater licensed production, with a defense R&D emphasis on subsystems that could be incorporated into licensed systems and used as bargaining leverage in negotiating technology

[28]For details on TRDI's efforts to build Japan's technology base for development of the FS-X, see Samuels, op. cit., pp. 233-236.

[29]*Nikkei Business*, op. cit.

[30] Japan's ambition to join the front ranks of the commercial aircraft industry continues to face challenges, as seen in the prospects for the 100-seat YSX. Uncertainties about the market, possible competition and gaining foreign cooperation on favorable terms threaten the project. See Hirofumi Matsuo, "China-Korea Aircraft Plans Threaten YSX," *The Nikkei Weekly,* July 17, 1995, p. 17.

Box 4-2 The FS-X Program

Sweeping conclusions about the FS-X are premature, since the development phase is only now reaching a conclusion, and critical issues such as the actual performance and procurement of the aircraft have yet to be resolved. The process of structuring this U.S.-Japan codevelopment program marked something of a watershed in Japan's security policies and U.S.-Japan relations.

Soon after the launch of F-15 licensed production in the late 1970s, the Japan Defense Agency, Air Self-Defense Force, and industry began considering options for replacing the domestically-developed F-1 fighter. Japanese industry and some elements in the government began the process with a presumption in favor of a domestically developed fighter. Increasing domestic content, gaining greater managerial control over the program than was possible in a licensed production arrangement, and controlling costs (the costs of licensed U.S. aircraft increased by an average factor of four with each program from the F-86 to the F-15) were all considerations. Perhaps the most important factor was an underlying sense that Japan's position in the aircraft industry was fragile, and that passing up domestic development would consign Japan to a follower role forever.[1]

By the time serious feasibility studies were launched in 1986, the momentum in Japan for a domestic aircraft was quite strong. During 1986 DoD became increasingly concerned with the specifications and low development cost estimates, and began a more aggressive push for the FS-X to be based on an existing U.S. design. In October 1987 the United States and Japan reached an agreement to "codevelop" an FS-X based on the General Dynamics F-16 design.

Through late 1987 and 1988 a memorandum of understanding (MOU) for the development program was negotiated and then was signed in late 1988. With the Bush administration coming into office in early 1989, congressional concerns over the FS-X agreement were raised in confirmation and other hearings. Contentious debate over the agreement continued through the spring of 1989, with opponents arguing that F-16 technology transfers would contribute to Japanese competitiveness in commercial and military aircraft—to the long-term detriment of U.S. industry—that off-the-shelf Japanese procurement of F-16s would cut the huge U.S. trade deficit with Japan while addressing Japan's security needs more economically, and that Japanese technical capabilities were not high enough for the flowback provisions to deliver many benefits to the United States. U.S. proponents argued that significant U.S. participation in the FS-X program was better than none at all, that Japanese procurement of unmodified F-16s was not a realistic scenario, and that flowback would bring considerable benefits.

In the end congressional opponents were not able to stop the FS-X agreement but were able to force DoD to gain a "clarification" of several key points. First, the Japanese explicitly committed to a 40 percent U.S. work share during the development phase and to providing access to Japanese-developed technologies. Second, the denial of several key F-16 technologies—including computer source codes, software for the fly-by-wire flight control system, and other avionics software—was made explicit.

The episode threw into sharp relief the contrast between the contentious divisions over Japan policy in the United States and the much more united front—albeit with some bureaucratic infighting—that Japan presents to the United States in bilateral negotiations. In addition, the contention left heightened resentment on both sides.

The first FS-X prototype was "rolled out" in January 1995. Development was delayed during 1991 and 1992—in part because of sanctions placed on Japan Aviation Electronics after it was found to have violated export controls.[2] Japanese decisionmaking on FS-X production and negotiation of a U.S.-Japan MOU on the production phase (assuming the fighter goes into production) lie in the future. One complication is possible disagreement over development issues, particularly flowback. The original development MOU defined four areas of nonderived technology, meaning that U.S. companies could license technologies in those areas for a fee, but would be entitled to Japanese developments in other areas at no charge.[3] Although the FS-X is politically dormant as this is written, Japan is reportedly seeking to reclassify a number of technologies as nonderived, a move that could reignite controversy.[4]

Keeping in mind the remaining uncertainties, it is possible to draw the following preliminary conclusions about the FS-X program: (1) contention surrounding the negotiation and clarification of the development MOU serves as an important warning—the exercise strained mutual trust and left significant constituencies on both sides thinking that the agreement represents a "giveaway" to the other side; (2) despite controversial beginnings and delays, outlined above, the industry-to-industry relationships, including the flowback of composite wing technology to Lockheed Martin's Fort Worth division from Mitsubishi Heavy Industries, are reported to be working effectively; (3) notwithstanding the flowback data, the major benefit to the United States from the program is the licensing and sales income for participating U.S. companies, rather than technology flow from Japan[5]; (4) U.S. government and industry structures designed to manage traditional international security and defense industry relationships were shown to be inadequate to reconcile trade-offs between the various fundamental U.S. interests at stake; and (5) as a result of the FS-X experience, both countries will likely be wary about pursuing codevelopment in the future.

The FS-X case highlights several of the central questions with which this study is concerned, including whether traditional licensed production arrangements with Japan involving one-way technology flows continue to serve U.S. interests and how U.S. government and industry should organize themselves to integrate and pursue a broader set of U.S. interests.

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[1]Chinworth, op. cit., p. 138.

[2]In 1991 Japan Aviation Electronics (JAE), which was responsible for developing the inertial guidance system and the software for the flight control computer of the FS-X, was found to have repaired and reexported components for guidance systems used by Iran in Sidewinder missiles and of selling parts to Iran for use in American-made F-4 fighters. Japanese government sanctions blocked JAE from exporting for 18 months; U.S. Department of State sanctions prevented JAE from working on the FS-X program for a number of months, until a settlement was reached that allowed JAE to purchase U.S. military products only in order to supply the Japan Defense Agency. See Japan Economic Institute, *JEI Report*, September 13, 1991, p. 5; November 8, 1991, pp. 12–13; and April 3, 1992, pp. 7–8.

[3]The four nonderived technologies are all in avionics: the phased array radar, the inertial reference system, the integrated electronic warfare system, and the mission computer. The composite wing is considered derived. More recently, the United States and Japan agreed to reclassify electromagnetic wave-absorbing material as nonderived. See "Royalties to Japan," *Aviation Week and Space Technology*, April 1, 1994, p. 13.

[4]Andrew Pollack, "A New Warplane's Murky Horizon," *The New York Times*, January 13, 1995, p. D1.

[5]Ibid.

transfers. It is possible that for some areas and systems Japan will pursue a technology-oriented strategy and that in others it will pursue a manufacturing-oriented strategy.[31]

U.S.-Japan Codevelopment of Defense Systems

This is a collaborative mechanism with which the United States and Japan have had little experience thus far. The only example is the FS-X fighter, which is quite different from most codevelopment programs, as described below. Codevelopment is an increasingly popular form of international collaboration in weapons development worldwide, but most of the successful (as well as unsuccessful) examples to date come from Europe.[32] There are also important differences between the FS-X and European codevelopment programs, such as the Anglo-Italian-German Tornado fighter. For example, in European programs all of the countries participating in development and production normally enter the venture with an intention to procure the system, and the program is generally integrated from the concept evaluation stage. In the case of the FS-X, American F-16 technologies were used as a basis for the program, Japan has taken the leading role in development, the U.S. side receives licensing income and flowback, and the fighter—if it does go into production—will be procured only by Japan.

At first glance it would appear that both the United States and Japan would have increasing motivation to pursue codevelopment, owing to the budget constraints in each country. For example, a number of U.S. weapons programs have been delayed or canceled in recent years.[33] It is conceivable that one or more of them might fit in with Japanese operational requirements or ongoing development programs. U.S.-Japan codevelopment could be a solution for bringing some of these programs forward.

However, even if the United States and Japan can define a mutual interest in one or more such systems, there would be several obvious challenges in structuring a program. First, the unequal technological levels of U.S. and Japanese defense companies, combined with differences in most U.S. and Japanese requirements, would stand in the way of forming "consortia of rough equals" along the lines of European programs.[34]

Perhaps a more promising codevelopment model would be a U.S.-led effort in which Japanese companies play the role of key subcontractors, developing and producing subsystems for weapons that would be procured and fielded by both sides.[35] This would be analogous to the

[31]Private advisory committees to the JDA issued reports recently on defense production and defense technology. Boei Sobihin Chotatsu Kondankai (Advisory Committee on Defense Equipment Procurement), *Boei Sobihin Chotatsu Kondankai Hokokusho*, December 1993, notes the difficult environment for defense production and recommends adopting stable, medium-term budgeting plans to aid industry planning, streamlining the acquisition process, and increasing the use of items with commercial specifications. Boei Sangyo Gijutsu Kondankai (Advisory Committee on Defense Industry Technology), *Boei Sangyo Gijutsu Kondankai Hokokusho*, March 1994, also recommends stable planning, and calls for more effective U.S.-Japan cooperation. The latter report identifies four key defense technologies that Japan should focus on for the future: software, sensors and data-processing, robots, and materials.

[32]American companies have been involved in some codevelopment programs, such as the AV-8B Harrier II with Britain. See Richard A. Blitzinger, "The Globalization of the Arms Industry: The Next Proliferation Challenge," *International Security*, Fall 1994, pp. 170-198.

[33]John Mintz, "Defense Memo Warns of Cuts in Programs," *The Washington Post*, August 22, 1994.

[34]European weapons consortia have had a high rate of failure. There are indications, however, that the success rate may be improving with experience.

[35] According to a recent MIT Japan Program study, Japanese defense contractors believe that U.S.-Japan cooperation in developing subsystems is a promising mechanism for enhanced interaction. See Green, op. cit.

approach used by Boeing, General Electric, and Pratt & Whitney in structuring international commercial airframe and jet engine programs. In this case, however, Japan's arms export ban could complicate or prevent Japanese-developed or manufactured parts from being incorporated into systems procured by the United States, making such cooperation less attractive for Japanese industry (see Box 4-3).[36] If systems-level codevelopment focused on JDA requirements, it would almost ensure asymmetries—Japan would inevitably be providing most or all of the funding. On this basis, codevelopment would probably resemble a licensed production program with more scope for technological contribution by Japan (similar to FS-X), rather than an integrated collaborative effort in which both sides have a comparable stake. In this circumstance it would be difficult to avoid the traditional pattern of one-way technology flow.

Notwithstanding these sorts of obstacles, one area for U.S.-Japan cooperation in defense technology that has been discussed recently is theater missile defense (TMD) (see Appendix D). The basic objective of TMD is to provide protection for U.S. and allied forces and civilian populations against ballistic missile attacks in a limited region. Some analysts also believe that credible TMD capabilities can deter possible adversaries from expensive efforts to develop and deploy ballistic missiles. Concern about possible ballistic missile threats in Japan has been prompted primarily by the activities of North Korea.[37] In addition to concerns about its efforts to produce nuclear weapons, North Korea is developing ballistic missile capabilities that would enable it to attack Japan. Furthermore, while Japan currently enjoys stable relations with Russia and China, both nations possess nuclear ballistic missiles capable of striking Japan. Japan, because of its relatively small geographic area, is well suited to TMD; indeed, for Japan a TMD system would approximate national missile defense.

The United States has made significant investments in technologies related to missile defense over many years. Three programs form the core of U.S. near-term plans to introduce more advanced ballistic missile defense systems. Patriot antitactical ballistic missile (ATBM) capabilities will be improved with upgraded software, electronics, and missiles incorporated into the PAC-3 expected in late 1998 or early 1999. Navy Aegis destroyers are expected to be equipped with extended-range missiles modified to perform the "lower tier" ATBM role in 1999. Theater high altitude area defense (THAAD) missile systems coupled to long-range, ground based radar for ballistic missile defense beyond the range of Patriot are expected to reach Army field units in 2001.[38]

Limited funding and technical uncertainties have delegated three other ballistic missile defense programs to longer-term development. The Corps SAM (surface-to-air missile) program would provide mobile ATBM capabilities to U.S. Army forces. Either sea-based THAAD or the addition of Aegis ATBM missiles with LEAP (lightweight exo-atmospheric projectile) capabilities would give the Navy "upper tier" ATBM capability expanding the range of coverage beyond the currently planned Aegis ATBM system. Finally, several options exist for a boost/ascent-phase ballistic missile intercept capability.[39]

[36]This sort of arrangement appears to work very well in commercial aircraft production. See Box 4-3 for a discussion of Japan's arms export controls.

[37]Susumu Awanohara, "My Shield or Yours?", *Far Eastern Economic Review*, October 14, 1993, p. 22.

[38]David Hughes, "BMDO Under Pressure to Set TMD Priorities," *Aviation Week and Space Technology*, January 17, 1994, pp. 49-50.

[39]Ibid.

Box 4-3 Japanese Restrictions on Weapons Exports

Although Japan's "three principles" governing arms exports and subsequent policy statements are not legislation, they have been in force for a number of years and carry considerable political force. In 1967 Prime Minister Sato declared the three principles, stating that arms exports would not be permitted to: "(1) Communist bloc countries; (2) Countries to which the export of arms is prohibited under United Nations resolutions; and (3) Countries which are actually involved or likely to become involved in international conflicts."[1]

The 1967 declaration was supplemented in 1976, when Prime Minister Miki announced the "Unified Government View of Arms Export," which reaffirms the three principles and goes on to state that "the export of arms to other areas which are not subject to the three principles shall be restrained in line with the spirit of the Constitution and Foreign Exchange and Foreign Trade Control Law. . ." and that "equipment related to arms production shall be treated in the same category as 'arms'."[2] This statement also defines "arms" to mean "what military forces directly use for combating." In 1981 both houses of the Japanese Diet adopted a resolution reaffirming the three principles and calling for institutional improvements to deal with arms exports in light of "instances which contravened the stated government policy."[3]

In 1983 an exchange of notes between the United States and Japan was completed, allowing for the transfer of Japanese military technology, along with articles necessary to make technology transfer effective, to the United States as an exception to the three principles.[4] Japan's export controls are administered by the Security Export Controls Division of the Ministry of International Trade and Industry (MITI).

Although a wide range of U.S. policymakers and other experts agree that continued Japanese adherence to the three principles is consistent with U.S. interests, the experience of the National Research Council Defense Task Force members and expert briefings during the course of the present study raised two areas in which the implementation of Japanese policies can act as a barrier to cooperation. The first area involves cases in which U.S. companies have wanted to incorporate Japanese components based on commercial technology into their defense systems or subsystems, but where a minor modification of the component was necessary for the defense application. Japan's enforcement of its export controls allows for minor modifications on a case-by-case basis.[5] However, the Defense Task Force is aware of instances in which American companies have been told by Japanese counterparts that components embodying commercial technology with minor modifications for a defense application would be prohibited. In several cases, the U.S. company followed up by pursuing a technology license, which is clearly allowed under the exchange of notes, but was refused due to the Japanese counterpart's concerns that the licensed technology would be utilized to make competing commercial products.[6]

It is the impression of a number of U.S. and Japanese observers that Japanese companies may invoke the three principles when collaboration with U.S. defense contractors is not desirable for other reasons.[7] An underlying technology might have been developed in order to manufacture commercial products for a large market. The market represented by a component sale to a U.S. defense system might be quite small in comparison, but developing the component could require a considerable engineering effort. Japanese companies were reluctant to develop flat panel displays for the U.S. companies supplying avionics for the Boeing 777, a purely commercial

venture that also required a significant engineering effort for a limited market.[8] Due to the political sensitivity Japanese companies feel to becoming known as "arms makers," many firms are reportedly reluctant to do business with JDA, let alone DoD.

In at least one case of refusal on the part of Japanese companies to transfer technology to U.S. companies in which the "three principles" have been implicated or invoked, it appears that concerns about potential competitive utilization of the technology may have been involved. For example, Mitsubishi Heavy Industries (MHI) rebuffed McDonnell Douglas's effort in the 1980s to license technology connected with the LE-5 engine for Japan's H-I rocket, ostensibly because the technology might be used to launch military spacecraft.[9] However, as the technology's application in Japan was purely commercial, a very strict interpretation of the principles would have been required to restrict such a license. Procedures for transfers of military technology to the United States also existed at this point, and could have been utilized had it been necessary to classify the technology as military. In another case in the early 1980s, General Motors expressed interest in licensing technology used in the production of MHI's 74-type tank, particularly the sophisticated hydraulic suspension systems and transmission, but was also rebuffed.[10] In this case, which involved clearly military technologies, MHI was reportedly reluctant to provide a test case for the MOU allowing transfer of military technologies to the United States, which had been concluded a short time before. In any case, a number of cases—both those that have been made public and those which the companies involved appear unwilling to disclose—demonstrate a pattern of reluctance on the part of Japanese companies to license military and dual-use technologies to the United States.

For the purpose of enhancing U.S.-Japan cooperation and for DoD and U.S. industry planning, a more transparent way of determining which Japanese exports might violate the principles could facilitate expanded industry-to-industry interactions, particularly in pursuing opportunities to incorporate Japanese commercial technologies in U.S. military systems. Options for achieving this are discussed in Chapter 6.

Current interpretation of the three principles can also act as a barrier to the transfer of Japanese military technologies through the procedures established in the 1983 exchange of notes. As noted earlier, this change has not resulted in a significant flow of technologies from Japan to the United States. This is due not only to the limited nature of Japan's defense technologies but also to the understanding that Japanese defense technologies transferred to the United States will not be retransferred in any form to third parties.

For example, if Japan develops an improved component or subsystem for a U.S. system that it is producing under license, it would seem to be in the spirit of the exchange of notes that the United States could obtain this improved technology, manufacture a component or subsystem based on the technology, and incorporate it into the U.S. system. However, for systems commonly subject to FMS sales—and many of the systems Japan is producing are—the retransfer restrictions make this awkward or impossible. Under the present system, in order to accommodate Japan, the United States would have to maintain inefficient production and supply of less capable FMS versions of the parts and subsystems in question in addition to the improved versions incorporating Japanese technology. Naturally, the U.S. military and U.S. industry might be less motivated to pursue cooperation with Japan in upgrades knowing that difficulties could arise down the road. The United States routinely imposes similar retransfer restrictions on its allies.

Options for ameliorating this barrier are considered in Chapter 6 of this report. Any solution would have to address legitimate Japanese concerns and establish a system for royalty payments to Japanese companies.

With tightening defense procurement budgets in Japan, possible policy changes related to the three principles are under active discussion in Japan. The Japan Federation of Economic Organizations (Keidanren) has provided the impetus for this discussion.[11]

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[1]Japan Defense Agency, *Defense of Japan 1994*, op. cit., p. 245.

[2]Ibid.

[3]Ibid., p. 246.

[4]Ibid., p. 247, contains the Chief Cabinet Secretary's statement. The actual exchange of notes, which is more detailed, is contained in Defense Science Board, *Industry-to-Industry Armaments Cooperation Phase II—Japan* (Washington, D.C.: Office of the Under Secretary of Defense for Research and Engineering, 1984), pp. 133-138.

[5]Communication from MITI, April 1995.

[6]Because of concerns about damage to business relationships with the Japanese government and Japanese companies, U.S. companies are reluctant to air their particular cases publicly. See below for discussion of cases that have emerged in public.

[7]Rubiner, op. cit., p. 21.

[8]National Research Council, *High-Stakes Aviation*, op. cit., pp. 54-55.

[9]Japan Economic Institute, *JEI Report*, October 23, 1987, p. 7.

[10]Japan Economic Institute, *JEI Report*, June 15, 1984, p. 6.

[11]See Keidanren, "A Call for a Defense Program for a New World Order" (provisional translation), May 11, 1995. The provisional translation urges the Japanese government to lay the groundwork for joint R&D and production with the United States by "resolving such issues as the appication of Japan's export control policy, the handling of the fruits of joint R&D, and protection of enterprises' commercial rights in the case of dual-use technologies." Some Japanese press reports have Keidanren calling for an actual exception to the three principles for component exports to the United States. See "Keidanren ga Kanwa Yobo" (Keidanren Urges Easing), *Nihon Keizai Shimbun*, May 12, 1995, p. 1.

Japan already possesses or is procuring some rudimentary elements of a TMD system, but these systems would have to be upgraded to perform TMD functions.[40] U.S.-Japan collaboration in the ballistic missile defense area goes back to the late 1980s, when several Japanese companies received contracts from DoD as part of the WESTPAC project, an initial study of ballistic missile defense requirements in the Western Pacific.[41] Last year, U.S. defense officials reportedly proposed a series of four possible TMD "options" to Japan.[42] More recently, a U.S.-Japan joint study of Japan's TMD needs was launched under the leadership of JDA.[43]

The United States has several important interests at stake in TMD cooperation with Japan. First, Japanese deployment of TMD would contribute to the defense of Japan—for which the United States shares responsibility—and would protect U.S. forces in Japan as well as Japanese

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[40]Awanohara, op. cit.

[41] Hironobu Sakamoto, "Japanese Firms Win SDI Research Contracts," *Japan Economic Journal*, December 17, 1988.

[42]Naoaki Usui, "Japan Tackles Antimissile Options," *Defense News*, August 29, 1994, p. 1.

[43] "Raigetsu TMD Kenkyu-shitsu," (Next Month TMD Study Group), *Nihon Keizai Shimbun*, March 27, 1995, p. 2.

citizens. Credible capabilities could also help deter Asian countries from developing ballistic missiles and weapons of mass destruction. A second interest is possible technological benefits from joint development and related activities. If Japan decides to deploy TMD and wishes to license produce some of the component systems, resulting in a significant transfer of technology to Japan, the United States would likely pursue a reciprocal flow of technology from Japan to the United States.[44] This could take place through cooperative R&D on undeveloped systems, or insertion of leading edge Japanese technology into the TMD system. Finally, Japanese procurement would benefit the United States by allowing U.S. development costs to be spread over a larger production volume, and some savings could be realized if agreement can be reached on U.S.-Japan codevelopment of one or more of the component systems.

Although U.S.-Japan cooperation in TMD has a compelling logic and the possible benefits to both sides are clear, there are a number of potential challenges that must be overcome to structure a mutually beneficial program. One set of obstacles on the Japanese side is related to the lack of a political consensus in favor of deploying a ballistic missile defense system.[45] Other obstacles are related to more narrow defense issues. For example, deployment of TMD by Japan would likely require a new level of interservice cooperation within the Self-Defense Forces. Further, the program would likely involve substantial purchases of U.S. equipment, even if some component systems are license produced. In a time of tight budgets, it would be more difficult to acquire other systems with strong constituencies in the Self-Defense Forces.

Pursuing a consistent and balanced U.S. strategy toward cooperation could be difficult in light of the various interests and stakeholders involved on both sides. For example, the friction resulting from the early link between TMD and DoD's TFT initiative illustrates one potential point of contention.[46] At subsequent stages of discussion, U.S. efforts to negotiate a reciprocal technology flow could be resisted or misrepresented in Japan. Another possible challenge could arise if a U.S. approach focusing on the security and cost-spreading benefits of Japanese participation results in an agreement that draws opposition within the United States because of a perceived continuation of one-way technology transfers to Japan.[47] It appears that close coordination and advance work by the U.S. government and U.S. industry to develop possible areas for Japanese technical contributions will be necessary. Absent careful planning, there is a danger that, as in the FS-X negotiation, the effort to cooperate with Japan could put strains on the U.S.-Japan relationship without advancing other significant U.S. interests.

Although TMD could be a promising area for U.S.-Japan technology collaboration, it illustrates the major challenges and risks facing both countries in building a new security and defense technology relationship for the post-Cold War era.

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[44] When the possibility of implementing the DoD's TFT initiative through TMD cooperation was raised by the United States early in the discussions of TMD, it was resisted by some on the Japanese side. Partly as a result, the TFT and TMD discussions were "delinked." See Barbara Wanner, "Washington Pushes for Expanded U.S.-Japan Defense Technology Exchanges," *JEI Report*, April 8, 1994, p. 6.

[45] There is also debate in the United States concerning the scope of ballistic missile defense efforts that are permissible under the ABM Treaty with Russia, and whether a modification of the treaty should be pursued.

[46] "Gokai oi seniki misairu boei" (Misunderstanding Surrounds TMD), *Nihon Keizai Shimbun*, November 3, 1993, p. 2.

[47] Possible Japanese financial contributions are discussed in Barbara Opall and Naoki Usui, "DoD Courts Japan for Sea-Based Defense," *Defense News*, June 6-12, 1994, p. 1.

Cooperation in the Development of Subsystems, Military Technologies, and Upgrades of Systems Deployed by Both Countries

Cooperation in developing subsystems, military technologies, and upgrades of systems deployed by both countries are closely related mechanisms. The scale of a given project is generally much smaller than the large licensed production, codevelopment, and other programs discussed above.

The Systems and Technology Forum (S&TF) is the institutional setting for the United States and Japan to explore and develop possible projects. As part of the DoD's TFT Initiative, recent efforts have focused on revitalizing S&TF to explore opportunities for cooperation in military and dual-use technologies of interest to DoD and JDA. Table 4-2 shows collaborative projects currently under way or under discussion.

Since Japan and the United States deploy many of the same systems, and the development of new systems is slowing, the development of new subsystems or subsystem improvements to upgrade and retrofit older weapons with modern technology is one area of possible cooperation that has a strong fundamental logic. For example, at the S&TF meeting of December 1994, the two countries discussed joint upgrades to the F-15 fighter. Japan has shown interest in introducing more advanced electronics into the fighter's control system.[48] The two countries also deploy the Patriot missile, the P-3, and other systems in common.

However, there are barriers to utilizing this mechanism to what would appear to be its full potential. For example, the export of U.S. manufactured items incorporating Japanese military technology is restricted under current policies. Since many of the systems the United States deploys in common with Japan are subject to FMS, incorporating Japanese technology might require the United States to maintain two subsystems manufacturing and maintenance capabilities—one for the newer, presumably more capable subsystem incorporating Japanese technology for U.S. procurement and one for the older subsystem to be used for FMS.

Most of the other projects that are ongoing or under discussion through S&TF, such as the ducted rocket engine, eye-safe laser, and ceramic tank engine, accomplish their collaboration through joint visits by military and industry researchers, data exchange, and joint development of demonstrators. Up to this point, this interaction has consisted of relatively small-scale joint R&D projects and therefore should not be expected to serve by itself to redress the imbalance in U.S.-Japan technology flows.[49]

However, the potential exists to build collaborative R&D in defense technologies into a more effective mechanism in the future than it has been up to now. With longer development and procurement cycles, greater emphasis in the United States on the development of weapons by teams of U.S. companies, and ongoing tight defense R&D budgets, U.S. companies are finding it increasingly difficult to support long-term R&D on enabling technologies for future defense systems. Japanese companies may be facing some of the same problems as a result of tight defense budgets. Collaboration between U.S. and Japanese companies in R&D on enabling technologies could prove to be an important mechanism for leveraging scarce resources in the future. The key will be to focus S&TF or some other forum on industry-to-industry

[48]The two countries have established a working group to discuss F-15 upgrades. See "Military Technology on Agenda," *Nikkei Weekly*, December 12, 1994, p. 2, and "F-15 kaizo e semmon-in" (Working Group for F-15 Upgrades), *Nihon Keizai Shimbun*, December 15, 1994.

[49]Michael J. Green and Richard J. Samuels, *U.S.-Japan Technology Cooperation: Ten Guidelines to Make it Work* (Cambridge, Mass.: MIT Japan Program, 1994), pp. 6-7.

collaboration. Building an effective program or set of programs will likely require a patient effort on both sides. Chapter 6 will review options for removing barriers to greater collaboration in upgrading subsystems and for encouraging beneficial collaborative R&D in defense technologies.

TABLE 4-2 U.S.-Japan Collaborative Technology Projects Under the Systems and Technology Forum (S&TF), Current and Under Discussion

Ducted Rocket Engine The MOU was signed in September 1992 and the project, involving the integration of ducted rocket technology into medium-range surface-to-air missiles, is progressing. An number of components are in various stages of development with planned completion of the demonstrator in 1997. Hardware and technology transfers are ongoing. Primary participants are U.S. Army Missile Command and TRDI; there are private contractors on both sides.
Vehicle Propulsion Using Ceramic Materials The MOU is in the final stages of negotiation and expected to be signed in fall 1995; agreement has been reached on work shares and schedules. The project involves the use of ceramic materials in higher-performance diesel engines for application in ground-based fighting vehicles. Each side will produce demonstrators for comparison. Primary participants are U.S. Army Tank-Automotive Research, Development, and Engineering Center, Army Research Laboratory, and TRDI.
Advanced Steel Technology The MOU is being finalized for development of high-strength, low-cost steel plate and undermatched welding technology for use in naval construction. Primary participants are U.S. Department of the Navy and JDA.
Dual-Mode Seeker The project, combining millimeter wave and infrared technologies into a single missile unit, was discontinued in December 1994 due to lack of funding and consensus on the U.S. side. The joint working group cochairman recommended that the group be disbanded and a Data Exchange Agreement be implemented, which is currently being reviewed by Army Materiel Command.
Eye-Safe Lasers A draft MOU is complete and unofficial negotiations are under way; authority to do so is contingent on the progress of the ceramic engine MOU. The project aims to develop eye-safe lasers, specifically an eye-safe radar for obstacle avoidance to be used in rotary-wing aircraft. Primary participants are U.S. Army Communications and Electronics Command, Japan Self-Defense Force, and TRDI.
Josephson Junction Superconductors Japanese industry participated in a feasibility study in 1993 and it is hoped that an existing MOU will be used for intergovernmental cooperation; Letters of Agreement are being negotiated in the meanwhile. The program is designed to increase capability in image processing using low-temperature superconductor technology; U.S. ability to produce high gate-count circuits would be enhanced by using the Josephson junction microprocessor. The transfer of Japanese computer chips and design information would be involved. Primary participants are BMDO, Jet Propulsion Laboratory, Department of Commerce, MITI, and JDA; there are possible private contractors on both sides.
Advanced Composite Materials Letters of Agreement are being negotiated. The project's objective is to apply closed-mold techniques in fabricating composite missile components. Primary participants are BMDO, Army Research Laboratory, MITI, and JDA; there are possible private contractors on both sides.

NOTE: Status of projects as of July 1995. SOURCE: U.S. Department of Defense.

5
U.S.-Japan Cooperation in Dual-Use Technologies: Pursuing Opportunities and Managing Risks

SUMMARY POINTS

• *In the future the United States will need to rely more heavily on commercial technologies in developing and procuring defense systems, including technologies in which Japan has developed considerable strength. This implies a need for greater access to Japanese commercial technologies and their utilization in defense systems. Japan has developed leading edge capabilities in a number of technologies with significant and growing defense applications, which could contribute to meeting U.S. security needs.*

• *Despite the large potential for mutual benefits, a focused, long-term effort will be needed to overcome barriers to beneficial cooperation. The most significant barrier is the lack of support in Japanese government and industry for facilitating the application of Japanese commercial technologies to U.S. defense needs.*

• *U.S. dependence on Japan and other countries for critical technologies and high-technology products for defense systems is an important issue that will require continuous attention. Some degree of dependence is inevitable. The key will be to manage dependence in order to minimize the risks and maximize the benefits of utilizing Japanese and other foreign technologies.*

• *Despite declining defense budgets, Japan is well positioned to continue to pursue commercial and industrial technology benefits from defense and security-related projects, including those involving international collaboration. This could lead to increased international competitiveness for Japanese companies, with implications for U.S. industry in areas such as aircraft and commercial space.*

ACCESSING JAPANESE COMMERCIAL TECHNOLOGIES FOR U.S. DEFENSE NEEDS

As discussed in Chapter 3, Japan's spending on defense technology development is very low relative to its total defense budget and the size of its overall R&D enterprise. Although the potential for achieving a more reciprocal U.S.-Japan defense technology relationship exists through several of the collaborative mechanisms discussed in Chapter 4, and there are areas of dedicated defense technology in which the United States would significantly benefit from greater exposure or access to developments in Japan, Japan's dedicated defense technology capabilities are likely to remain narrower and less developed than those of the United States.

However, Japan has developed considerable strengths in a variety of dual-use technologies. This is significant because the United States is currently engaged in a broad effort to increase utilization of the commercial technology base for defense systems.[1] There are two reasons for this effort. First, with ongoing defense budget cuts as a result of the end of the Cold War, there is a growing imperative to stretch and restructure weapons procurement and research and development (R&D). A greater use of commercial items and commercially derived technologies, particularly in subsystems and components, should reduce costs. The second reason for a greater U.S. Department of Defense (DoD) reliance on commercial technology is that in areas such as electronics, software, and materials, commercial technology developments are outpacing technologies developed solely for defense uses. In some cases, greater utilization of the commercial technology base would deliver benefits to U.S. weapons systems in the form of greater capability as well as lower costs.

Japanese strengths in microelectronics, advanced materials, advanced manufacturing, and other critical technologies are well known and comparable to the capability possessed collectively by our NATO allies. As noted, Japan's defense procurement and technology development policies have emphasized utilization of commercial technologies and civil-military integration, particularly at the components level.[2] There are a number of obstacles blocking DoD access to Japan's commercial technologies, including the fact that ownership often resides in Japanese companies that are not traditional Japanese defense suppliers; the Japan Defense Agency (JDA) and other Japanese government agencies might have little leverage.[3] Also, Japanese advantages in many high-technology fields tend to take the form of manufacturing practices and techniques that may be more difficult to transfer at arms length than "hard technology," which can be expressed in drawings and technical instructions. Finally, some have questioned the interest of U.S. companies in Japanese technology and the willingness of Japanese companies to transfer their technology.[4]

The National Research Council's (NRC) Committee on Japan organized several workshops in which representatives of U.S. companies discussed Japanese strengths in dual-use technology areas. One workshop focused on advanced composites, and the other on optoelectronics. Table 5-1 shows selected Ministry of International Trade and Industry (MITI) R&D programs in advanced materials and optoelectronics. These are not the only areas of Japanese technological strength in which contributions to meeting U.S. defense needs might be pursued, but they are useful examples that illustrate more general issues.

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[1]National Economic Council, National Security Council, Office of Science and Technology Policy, *Second to None: Preserving America's Military Advantage Through Dual-Use Technology*, 1995.

[2]Richard J. Samuels, *Rich Nation, Strong Army: National Security and the Technological Transformation of Japan* (Ithaca, N.Y.: Cornell University Press, 1994), especially Chapters 8 and 9. A succinct treatment is contained in U.S. Congress, Office of Technology Assessment, *Other Approaches to Civil-Military Integration: The Chinese and Japanese Arms Industries* (Washington, D.C.: U.S. Government Printing Office, 1995).

[3]A recent survey of U.S. government and industry representatives conducted by the MIT Japan Program discusses these obstacles in more detail. See Matthew Rubiner, *U.S. Industry and Government Views on Defense Technology Cooperation with Japan: Findings of the MIT Japan Program Survey*, 1994.

[4]Michael Green, *The Japanese Defense Industry's Views on U.S.-Japan Defense Technology Cooperation*, 1994, p. 18; Rubiner, op. cit., p. 20.

Advanced Composites

Advanced composites include areas of materials development and manufacturing as well as fabrication technologies for specific applications. The primary applications of advanced composites in the United States have been in defense systems—both missiles and military aircraft—and in commercial aerospace. Because of cuts in defense procurement, U.S. materials makers and composites fabricators have come under severe strains in recent years, and industry has cut its own R&D spending, even as U.S. government R&D support has increased.[5]

In a survey of U.S. companies active in this field, Japanese companies were mentioned most frequently as major foreign competitors.[6] Japanese companies built their composites capabilities by focusing on sporting goods and other commercial applications but are now internationally competitive in aerospace applications as well.[7] Japanese companies are focused on a number of process technology advances in composites with both commercial and military applications (see Table 5-2).

TABLE 5-1 Selected MITI R&D Programs Related to Optoelectronics and Advanced Materials

Project	1993 Funding (million dollars)	Project Timeframe
New information processing (real-world computing)	36	ten years
High-performance materials for severe environments	18	1989–1996
Nonlinear photonics materials	6	1989–1998
Advanced chemical processing technology	19	1990–1996
Silicon–based polymers	6	1991–2000
Quantum functional devices	7	1991–2000
Advanced material processing and machining system	17	1986–1993
Integrated inorganic materials	0.5	1993–?
Autonomous reaction materials	0.5	1993–?
Femtosecond technology	0.5	1993–?
Advanced internal inspection technology for composite substances (Tohoku region)	0.3	1990–1994
New forming technology for composites (Chubu region)	1	1993–1998
Wet forming fine ceramics (Chubu region)	0.1	1993–1998
Advanced surface modification in material processing (Kinki region)	0.3	1989–1993
Advanced design and manufacturing technology for precision modeling of sculpted surface forms (Chugoku region)	0.3	1991–1995

NOTE: Includes general and investment account funding. Some relevant R&D projects under energy conservation or other programs may not be included.
SOURCE: *AIST 1993*, Ministry of International Trade and Industry brochure.

[5]U.S. Department of Commerce, Office of Industrial Resources Administration, *Critical Technology Assessment of the U.S. Advanced Composites Industry* (Springfield, Va.: National Technical Information Service, 1993), p. i.

[6]Ibid., p. 132.

[7]This is illustrated by Toray's supply of materials to Boeing for the vertical tail fin on the 777—the largest composite structure thus far on a commercial aircraft. See National Research Council, *High-Stakes Aviation: U.S.-Japan Technology Linkages in Transport Aircraft* (Washington, D.C.: National Academy Press, 1994), pp. 46-48.

TABLE 5-2 Examples of Japanese Focus and Strength in Advanced Composites

Civil Engineering Applications The use of composites in civil engineering (buildings, roads, telephone poles, etc.) will become more attractive as the cost of composites goes down and environmental regulations limit the use of other materials. Large Japanese construction companies are cooperating with the Japanese government in launching demonstration projects, but U.S. materials companies do not have access to a comparable knowledge base because the U.S. construction industry does very little R&D.
Pitch-Based Carbon Fiber U.S. companies have deemphasized work in this area in the face of continuing challenges to lowering manufacturing costs, but several Japanese companies remain very interested and active.
Process Control for Pan-Based Carbon Fiber U.S. companies are competitive on a cost and performance basis, but it appears that Japanese companies turn out more consistent fiber.
Process Control for Prepregnation Japanese manufacturers exhibit superior consistency in turning out treated fibers, particularly very thin prepregnations.
Three-Dimensional Weaving, Preforms, and Tooling for Low-Cost Resin Transfer Molding (RTM) Building on the strengths of its textile processing and machinery industries, Japan has developed strengths in weaving fibers. The Japanese focus is on lowering the cost of preforms through automated weaving and flexible machines.
Cocuring This is the process being used to manufacture the FS-X wing. A Japanese focus is to bring down the parts count in order to lower cost. A large part of Japan's success in this area may be the result of work practices that may be difficult to institute in the United States.
Ceramic Fiber Manufacturing Ceramic composite materials development is a key enabling technology for future high speed commercial engines. Several Japanese companies continue developing improved versions of their fibers, despite the present low level of demand.

SOURCE: Compiled by Office of Japan Affairs staff. Based on discussions at the National Research Council Workshop on Japanese Advanced Composites Technology, 1993.

For example, the use of composites in civil engineering (buildings, roads, telephone poles, etc.) is likely to become more attractive as the cost of composite materials goes down and environmental regulations limit the use of other materials. Discussions at the NRC workshop indicated that, while large Japanese construction companies are cooperating with materials makers in exploring these applications, U.S. materials companies do not have access to a comparable knowledge base because the U.S. construction industry does very little R&D.[8] Access to the data resulting from Japanese demonstration projects would help U.S. materials companies prepare to serve these emerging markets. DoD interest in civil engineering applications of composite materials is reflected in funding by the Advanced Research Projects Agency (ARPA) of a university-industry consortium that seeks to develop the "knowledge, tools and techniques for building bridges and elevated highways from advanced composite materials."[9]

Another example of Japanese focus is three dimensional weaving, preforms, and tooling for low-cost resin transfer molding (RTM). Building on the strengths of its textile processing and machinery industries, Japan has developed strengths in weaving fibers. An ongoing MITI-sponsored project supports development of fiber weaving equipment.[10] The Japanese focus is on lowering the cost of preforms through automated weaving and flexible machines. Although U.S. companies are currently strong in RTM, the Japanese are focusing a major effort in this area.

A third example of Japanese strength in composite materials is cocuring. This is the process being used to manufacture the FS-X wing. The focus is to bring down the parts count in order to lower costs, which cocuring accomplishes. Discussions at the NRC workshop and a recent report by a panel organized by the Japan Technology Evaluation Center confirm a Japanese focus on incremental improvements in manufacturing practices to reduce cost, as opposed to greater U.S. reliance on computer modeling and basic materials research.[11]

Another characteristic of Japanese companies working in this area is consistent, long-term R&D funding in areas that many U.S. firms have abandoned due to uncertain short-term commercial prospects. Ceramic composite materials development is a key enabling technology for future high-speed commercial engines. Some U.S. companies are capable of making advanced ceramic fibers, but demand is currently quite low. Japanese companies continue to pursue advances, in part through government-sponsored R&D activities. Future applications of these materials include engines for high-speed civil transport aircraft.

Optoelectronics

The term "optoelectronics" refers to a diverse group of technologies and applications, including displays, optical storage, fiber optics and optical interconnect, imaging sensors, and illumination systems. Optoelectronics advances are contributing to U.S. military capabilities in a number of areas, including communications, sensors, and guidance systems. Along with information systems and modeling and simulation, sensors were recently singled out as a key

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[8] A discussion of Japanese activities in utilizing composite materials for civil engineering applications is contained in Dick J. Wilkins, Moto Ashizawa, Jon B. DeVault, Dee R. Gill, Vistasp M. Karbhari, and Joseph S. McDermott, *JTEC Panel Report on Advanced Manufacturing Technology for Polymer Composite Structures in Japan* (Loyola, Md.: International Technology Research Institute, 1994), pp. 55-76.

[9] Jeffrey Mervis, "Defense Conversion Comes to Campus," *Science*, March 25, 1994, p. 1676.

[10] Wilkins et al., op. cit., p. 18.

[11] Wilkins et al., op. cit., p. xix.

strategic investment priority by the DoD.[12] As a result of R&D investments made by U.S. government and industry targeting defense and information systems applications, U.S. industry has broad technological strengths in optoelectronics, with many leading-edge technologies being pushed forward by smaller companies.

Various optoelectronics technologies have also been applied in consumer and industrial equipment. Japanese companies have developed broad technological strengths largely based on their focus in these areas.[13] Table 5-3 lists areas of Japanese strength in optoelectronics discussed at the NRC workshop. Representative examples include compact disk players, fax machines, and hand-held video cameras. As in advanced composites, U.S. optoelectronics manufacturers surveyed by the U.S. Department of Commerce rate Japanese companies as their most capable foreign competitors.[14]

Many optoelectronics technologies and components have applications in both commercial and military systems. For example, large Japanese companies control a significant percentage of the consumer market for laser diodes, while a number of small U.S. companies produce expensive high-performance devices for military applications using similar basic technology. Incorporating Japanese manufacturing insights into these areas could help lower the production costs of U.S. firms. Japanese companies are also making fundamental technological breakthroughs in this field, a recent example being the development of a blue-light-emitting diode by Nichia Chemical, a small company based on the island of Shikoku.[15]

TABLE 5-3 Areas of Japanese Technological Strength in Optoelectronics

Blue and blue-green lasers and emitters
CD laser technology, including arrayed CD lasers and holographic focusing
High-speed external modulators
Solid-state optical sensors
Optical image stabilization techniques (camcorders)
Illumination systems
Liquid toner electrophotography and photoconductors
General array technology
Monolithic devices
Metal semiconductor metal detectors
Low-cost plastic fiber arrays

SOURCE: Compiled by Office of Japan Affairs staff. Based on discussions at the National Research Council Workshop on Japanese Optoelectronics Technology, 1994.

[12]Department of Defense, Director, Defense Research and Engineering, *Defense Science and Technology Strategy* (Washington, D.C.: Department of Defense, 1994), p. 12.

[13]Stephen Forrest, Larry A. Coldren, Sadek Esener, Donald Keck, Fred Leonberger, Gary R. Saxonhouse, and Paul W. Shumate, *Optoelectronics in the United States and Japan* (Loyola, Md.: Japanese Technology Evaluation Center, forthcoming).

[14]U.S. Department of Commerce, Office of Industrial Resource Administration, *Critical Technology Assessment of the U.S. Optoelectronics Industry* (Springfield, Va.: National Technical Information Service, 1994), p. V-2.

[15]Bob Johnstone, "True Boo-roo," *Wired*, March 1995, p. 136.

A U.S.-Japan collaborative research effort in optoelectronic devices is currently being implemented. The joint research program contemplates a user-broker system for prototyping and testing optoelectronic devices. Discussions were originally initiated by Japan under its Real World Computing program, organized by MITI. The National Institute of Standards and Technology (NIST) is the lead agency on the U.S. side.[16]

In addition, U.S. industry and government agencies are pursuing a number of domestic initiatives to improve U.S. capabilities, particularly in areas where Japan is strong, under the Advanced Technology Program of the Department of Commerce and the Technology Reinvestment Project administered by ARPA. Private groups involved include the National Center for Manufacturing Sciences and the Optoelectronics Industry Development Association. It may be possible to leverage these and other efforts in developing approaches to increase U.S. industry access to Japanese commercial technology for U.S. defense needs. Box 5-1 describes a promising example of a consortium of U.S. companies that is developing applications for graded-index plastic optical fiber, a technology licensed from a Japanese inventor, with support from ARPA.

Incorporating Japanese Commercial Technologies and Capabilities into U.S. Weapons Systems

As the discussion of advanced composites and optoelectronics illustrates, there are a number of important areas of dual-use technology in which Japanese strengths built through addressing commercial markets could be applied to meet U.S. defense needs. The scope for such cooperation will grow in coming years, as DoD's reliance on commercial technologies in these and other areas grows. However, except for cases in which DoD utilization of commercial components in areas dominated by Japanese companies is so extensive that it raises concerns about dependence—a topic discussed below—there are few examples of Japanese commercial technologies applied to U.S. defense needs.

In facilitating greater U.S.-Japan cooperation in this area, the role of industry-to-industry relationships is likely to be even more important than it is in the cooperative mechanisms focusing on particular defense systems, which were discussed in Chapter 4. Particularly where the application of Japanese manufacturing techniques is sought, technology transfer will often involve extensive interaction between U.S. and Japanese industrial partners.

There are several contexts and mechanisms through which Japanese commercial technologies could be incorporated into U.S. defense systems. Collaboration could be targeted at a specific subsystem or subsystem upgrade, as discussed in Chapter 4. Joint R&D on generic enabling technologies not linked to a specific program is another possible context. Likewise, the roles of the Japanese and U.S. governments may vary depending on the context. When U.S. defense contractors or subcontractors license Japanese technology or incorporate Japanese-made components embodying a given technology, the direct government role would ideally be minimal. Where technologies need to be moved forward to address specific defense needs, the Japanese and U.S. governments could play a more direct facilitating role. For example, DoD and JDA could work jointly to modify mechanisms that Japan has already used effectively to incorporate commercial technologies into its defense systems.

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[16]NIST has selected the Optoelectronics Industry Development Association (OIDA) as the U.S. broker. See "U.S. Chooses Optoelectronics Broker in Cooperative Effort with Japan," NIST press release, January 1995.

Despite the potential for mutual benefits in dual-use collaboration, activity to date has been minimal. This indicates that there are significant barriers to this form of collaboration. One issue that was discussed extensively in Chapter 4 is Japan's arms export policies. Second, although Japanese companies appear to be willing to incorporate their own technologies into joint projects, there is a strong perception that they are more reluctant to license their technologies for cash than are U.S. companies and that they are concerned about technologies being used against them in commercial markets.

Some analysts assert that a lack of interest in Japanese technologies on the part of U.S. companies is a major barrier. Although, clearly, U.S. defense contractors have been mainly motivated to cooperate technologically with Japanese companies due to a desire to access the Japanese market, rather than by a desire to access to Japanese technology, it is also clear that a number of U.S. companies have been rebuffed in their efforts to access Japanese technology over the years. Only if barriers to access are lowered on the Japanese side will it become clear whether lack of U.S. industry interest in Japanese technology is a serious barrier. As the optoelectronics case described in Box 5-1 illustrates, there are a range of leading edge dual-use technologies in Japan that U.S. industry is likely to pursue access to given a favorable or at least not hostile attitude on the part of Japanese government and industry.

Overcoming these obstacles is likely to require a focused, long-term effort by both countries. It will require more on the U.S. side than simply compiling lists of superior Japanese technologies. U.S. government and industry will likely need to jointly develop new approaches to building effective collaboration with Japanese counterparts. Part of this effort will involve developing new incentives for Japanese government and industry participation. Although there is a strong case to be made that expanded collaboration in this area would strengthen the U.S.-Japan alliance and Japan's security, it does not appear that Japanese government and industry are strongly supportive of the Technology-for-Technology initiative, which is aimed at bringing this about.

New incentives could take several forms. In the collaboration between Ishikawajima-Harima Heavy Industries (IHI) and Newport News Shipbuilding, a promising example described below and in Appendix B, U.S. government funding of the MARITECH program and the changing nature of global competition in commercial shipbuilding facilitated greater willingness to share technology on the part of Japanese industry. Other useful examples come from the semiconductor industry. Since the late 1980s, the number and scope of mutually beneficial U.S.-Japan alliances in the semiconductor industry have increased dramatically, as U.S. sales in Japan have grown.[17] Examples include the Motorola-Toshiba and Hitachi-Texas Instruments alliances. Although the U.S.-Japan Semiconductor Trade Agreement of 1986 (renewed in 1991), which stipulated a goal of 20 percent foreign penetration of the Japanese market, is strongly opposed by many in Japan and the United States, a strong case can be made that it has provided a framework of incentives that has contributed to the more reciprocal industry-to-industry relationships seen today.[18] Both positive and negative incentives may be necessary to facilitate collaboration in dual-use technologies that serves the long-term interests of both the United States and Japan. Specific approaches are discussed in Chapter 6.

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[17]See Electronic Industries Association of Japan, *Semiconductor Industry International Cooperation Update* (Tokyo: EIAJ, 1993).

[18]Laura D'Andrea Tyson, *Who's Bashing Whom? Trade Conflict in High-Technology Industries* (Washington, D.C.: Institute for International Economics, 1993), Chapter 4.

Box 5-1 Graded-Index Plastic Optical Fiber

A recent, interesting example of technology transfer from Japan to the United States in optoelectronics is graded-index plastic optical fiber. The technology was licensed from a Japanese individual inventor by Boston Optical Fiber, a small start-up company.[1] Currently, applications are being developed by a consortium of U.S. companies with funding from the U.S. Department of Defense Advanced Research Projects Agency (ARPA).

Plastic optical fiber was first developed by Du Pont for General Motors in the late 1960s, but achieving the performance necessary for widespread commercial application proved to be difficult. Du Pont suspended its development activities and licensed the technology in the late 1970s. Japanese companies have achieved some success in incremental improvements. Plastic optical fiber is now used in signs as well as in some medical and automotive applications. There has been no U.S. manufacturer for some time.

Boston Optical Fiber was launched in 1992 by Ed Berman, who anticipated a growing market for plastic fiber and was motivated to establish a U.S. source. As Berman was in the process of getting started, he learned of a breakthrough that had been made by a Japanese inventor. Interestingly, the inventor is a professor at Keio University who made the invention on his own and therefore owns all of the rights. The breakthrough, known as graded-index plastic optical fiber (GIPOF) allows plastic fiber to be used in high-band width data communications, which had previously been impossible.

Berman contacted the inventor and after about ten months of persistent effort was able to negotiate a nonexclusive license. At the same time, he was discussing the potential of the technology with program managers at ARPA, who were interested in the wide applicability of GIPOF and in facilitating the growth of a U.S. manufacturing source. ARPA recently agreed to provide $4 million in support to a consortium formed to develop applications for GIPOF, which includes General Motors, Honeywell, Boeing, and Boston Optical Fiber. The industry partners are providing $2 million in matching funds. This consortium is not part of the Technology Reinvestment Project that ARPA plays a leading role in administering.

[1]This material is drawn from *Business Week*, June 5, 1995, and communication with Boston Optical Fiber, June 1995.

Government Facilitation of U.S.-Japan Private Sector Collaboration that Strengthens the U.S. Defense Industrial Base

In an environment in which defense spending has dropped substantially, U.S. defense prime contractors and suppliers are following a combination of diversification, exit, and consolidation strategies. Many of these companies possess technologies, low-cost manufacturing capacity, and other capabilities that might be of interest to potential Japanese partners suffering under the recent yen appreciation. In addition, U.S. companies that have depended on DoD support to fund basic technology development—often of a dual-use character—are looking for ways to continue to access the same level of R&D activity while DoD support declines.

Although slower peak speeds prevent GIPOF from replacing glass optical fiber in intercity telecommunications applications, it could replace copper wire in local area network (LAN) applications, particularly those where weight is a consideration. Several of the other members of the ARPA-supported consortium have such applications in mind. Boeing, for example, would like to replace as much copper wire as possible in its aircraft. To start, it will focus on applying GIPOF to linking entertainment systems and other noncritical areas. As more automotive subsystems incorporate computer controls, the Delphi unit of General Motors anticipates that all automotive computers will eventually be linked with a master computer through a LAN. Honeywell will be working on the electronics to support these applications developments.

Boston Optical Fiber has just 15 employees at this writing, but anticipates rapid growth. The Japanese inventor of GIPOF has also licensed the technology to a group of Japanese companies that are collaborating in R&D work—Sony, NEC, Toray, and Toshiba.

This case illustrates that there clearly are cutting-edge technologies in Japan that U.S. industry and DoD are interested in transferring and developing. It also illustrates that technology transfer from Japan to the United States can be relatively straightforward. The relative ease of obtaining the license could be attributable to unusual features of this case that lowered or eliminated barriers that often exist for U.S. companies seeking to acquire Japanese technologies, barriers that are discussed extensively in this report. For one thing, Boston Optical Fiber was dealing with an individual inventor. It is relatively rare for cutting-edge inventions to be controlled by individual inventors in Japan, and more common for large Japanese companies to seek cross-licensing or technology in return for technology rather than an arms-length license for their breakthrough inventions.

Another relevant factor is dual-use. GIPOF is clearly a dual-use technology; LANs are pervasive in military information systems and weight savings from plastic fiber could enable a range of new military applications. However, the consortium is now focusing on clearly commercial applications. Although under Japan's export control policies it should be possible to license GIPOF and other Japanese dual-use technologies specifically to develop defense applications, it is often difficult or impossible because of uncertainties over export control interpretation and other factors.

This case illustrates how Japanese dual-use technology can be transferred to the United States to meet commercial and defense needs. In future cases where there is a basic willingness on the part of Japanese innovators to share technology, it should be possible to utilize similar mechanisms.

One example of collaboration that is currently ongoing is the Newport News Shipbuilding-IHI relationship (see Appendix B). Newport News has been largely dependent on government contracts for nuclear-powered aircraft carriers and submarines. In recent years, however, declining military acquisitions have necessitated a rethinking of the firm's future. A cornerstone of the shipyard's diversification effort has been a drive to enter the liquified natural gas (LNG) tanker market. After encountering obstacles, Newport News has been able to license IHI's SPB containment system for LNG tankers. The terms of the arrangement allow Newport News to use the SPB system on any contract, whether doing so in partnership with IHI and other shipbuilders or as an independent builder. The association with IHI has also allowed Newport News to assimilate advanced Japanese shipbuilding techniques that hold long-term potential for

improving the efficiency of its operations, better enabling it to compete in commercial shipbuilding markets.

IHI recognized several advantages in cooperating with Newport News in consortia to bid on LNG projects and in other areas. Newport News' large manufacturing capacity will enhance the competitive position of consortia in which it participates, particularly for large projects. IHI also perceived Newport News as having significant political influence within the U.S. government. Finally, a consortium that included a large U.S. partner would be well positioned to compete in the U.S. market, should it improve.

Since Newport News has not yet won a contract utilizing the license from IHI—either by itself or as part of a consortium with IHI and the other yards—it is impossible to assess the bottom-line benefits of the relationship at this point. Still, the case represents a promising example of how U.S. defense contractors might leverage international technological capabilities in order to diversify and address commercial markets.

The evolution in IHI's strategy may also be a harbinger of more general shifts in the international strategic alliance approaches of Japanese firms, which have traditionally been eager to enter alliances that enhance their technological capabilities but have been reluctant to share their own technologies. The growing need for Japanese companies to reduce manufacturing costs brought about by the long-term appreciation of the yen and fierce global competition—including competition between groups of Japanese companies—might lead to more U.S.-Japan business alliances in which technology flows from Japan to the United States.

The Newport News-IHI relationship has been further strengthened by their joint involvement in the Marine Systems Technology (MARITECH) program. MARITECH was initiated in 1993 to revitalize the U.S. commercial shipbuilding industry. Administered by ARPA, MARITECH functions much like the Technology Reinvestment Project. Firms submit proposals for projects to ARPA, and ARPA supplies matching funds to those deemed best able to contribute to the advancement of relevant technologies. Funding for 1994 was $30 million, with another $190 million allocated through 1998. MARITECH seeks to improve the competitiveness of U.S. shipbuilders by fostering the creation of technologies that will help American shipyards produce commercial vessels more quickly and profitably.

MARITECH represents a significant experiment in U.S. technology policy. As an existing program in which DoD is facilitating transfer of Japanese and other foreign technologies to build the dual-use capabilities of U.S. companies, it could serve as a model for future initiatives to the extent that it succeeds.

MANAGING DEPENDENCE ON JAPAN AND OTHER FOREIGN SOURCES FOR CRITICAL TECHNOLOGIES, COMPONENTS, AND EQUIPMENT

Reliance on foreign suppliers for critical military components and technologies and the related risks have attracted attention and concern in the United States over the past decade.[19]

[19]A number of studies and articles on this issue have been conducted in recent years, such as Institute for Defense Analysis, *Dependence of U.S. Systems on Foreign Technologies*, 1990; The Analytical Science Corporation (TASC), *Foreign Vulnerability of Critical Industries*, 1990; National Defense University, *U.S. Industrial Base Dependence/Vulnerability*, 1987; and Theodore Moran, "The Globalization of America's Defense Industries:

Japan has been a focus for rising concerns in this area because of its strong technological-industrial capabilities. The two most significant U.S. policy initiatives relevant to this discussion have addressed areas of U.S. weakness vis-à-vis Japan, with implications for dependence on Japan or Japanese denial of critical technologies—significant DoD financial support for the SEMATECH R&D consortium and the National Flat Panel Display Initiative announced in 1994.[20]

Japanese and other foreign producers may be able to supply components of better quality or lower cost or may be the only available source of a specific technology. However, foreign sourcing and dependence carry potential national security liabilities. These include (1) acute short-run risks of inadequate supplies of components or equipment for surge or mobilization contingencies; (2) longer-term risks of inadequate access to foreign technologies during the development phase for new systems; and (3) risks of spillover effects and generalized industrial erosion that the absence of domestic capabilities might have on upstream and downstream industries.

In short-term contingencies the key national security imperative for any critical component or piece of equipment is to obtain adequate supplies for peacetime surges in production or general mobilization. Concerns about foreign sources revolve around the possibility that adequate supplies would be blocked or otherwise unavailable. For example, foreign production sites or transportation channels might be destroyed or disabled by military action, natural disasters, or accidents. Foreign sources might also withhold supplies from the United States for political reasons.

The overall extent of foreign dependence and foreign sourcing is generally unknown, particularly at the lower tiers of the supplier base.[21] The preponderance of publicly available information indicates that foreign dependence, particularly dependence on Japanese sources at the lower tiers, is now extensive and that it increased during the 1980s.[22]

A good example for evaluating these concerns in the context of Japan is ceramic semiconductor packages.[23] Ceramic packages are key components for microelectronics installed in virtually every military system. Although there are several domestic suppliers, imports account for about 90 percent of identifiable defense shipments.[24] A single Japanese company, Kyocera, holds over half the world market, and most other significant players are Japanese, so foreign sources are few and concentrated. Kyocera is the largest domestic merchant supplier, but it

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Managing the Threat of Foreign Dependence," *International Security*, Summer 1990. These reports are summarized in U.S. Congress, General Accounting Office, *Assessing the Risk of DOD's Foreign Dependence* (Washington, D.C.: U.S. Government Printing Office, 1994). George Gilboy, "Technology Dependence and Manufacturing Mastery," MIT Department of Political Science unpublished paper, 1995, was also made available to the Defense Task Force for this analysis.

[20]SEMATECH received DoD support from its inception in 1987 and recently announced that it would no longer need government support from 1997.

[21]U.S. Congress, General Accounting Office, *Significance of DOD's Foreign Dependence* (Washington, D.C.: U.S. Government Printing Office, 1991), p. 1.

[22]For example, U.S. Department of Commerce, Office of Industrial Resource Administration, *National Security Assessment of the Domestic and Foreign Subcontractor Base: A Study of Three U.S. Navy Weapon Systems* (Washington, D.C.: U.S. Department of Commerce, 1992).

[23]U.S. Department of Commerce, Office of Industrial Resource Administration, *The Effect of Imports of Ceramic Semiconductor Packages on the National Security: An Investigation Conducted Under Section 232 of the Trade Expansion Act of 1962* (Springfield, Va.: National Technical Information Service, 1993).

[24]Ibid., p. ES-5.

imports critical materials to its U.S. facility.[25] Further, Kyocera is clearly uncomfortable about the public relations aspect of supplying packages that are used in weapons systems.

Most of the criteria for evaluating the risks of acute dependence indicate that relying on Japan for ceramic packages represents a relatively high risk. U.S. merchant production of ceramic packages has declined in recent years, as several domestic producers have scaled back production or exited the business, and remaining producers have cut back investment and R&D. In early 1993 two of the remaining domestic producers petitioned the Department of Commerce to conduct an investigation under Section 232 of the Trade Expansion Act of 1962. Although the U.S. government ruled following the investigation that imported ceramic packages do not represent a threat to national security, the weakness of the domestic production base was recognized, and an action program focusing on technology development and manufacturing was instituted in 1993.

Dependence carries two types of long-term risks, both of which are technology-related. The first is that lack of U.S. capabilities in a given critical technology might delay or inhibit incorporation of that technology into new systems. For a number of reasons, foreign sources may be unwilling or unable to supply the United States with the technologies needed for modernization.

The current situation in flat panel display technology serves to illustrate this type of risk. DoD has stated that reliance on commercial technologies must increase in order to lower acquisition costs and because in areas like electronics commercial technology is outstripping advances on the military side. Today, several small specialized U.S. vendors supply DoD's requirements for flat panel displays. Although these domestic suppliers are technologically sophisticated, U.S. display producers are not present in the high-volume markets, such as laptop computers, that are driving manufacturing technology and cost reductions. DoD officials have stated that it will be necessary to have advance access to prototypes, assured access to customized products utilizing the latest commercial technology, and the benefit of lowered cost that comes from volume production. Japanese manufacturers, the dominant players, have reportedly indicated that they are not willing to work with DoD on its specialized needs.[26]

In 1994 DoD announced a Flat Panel Display Initiative to help facilitate an expanded U.S. manufacturing and market presence. The initiative has several elements, including core technology funding, R&D support for companies that commit to build production facilities, aggregation of government procurement demand, and interagency monitoring. The total cost over five years is expected to be $587 million.

Some experts have criticized DoD's approach, saying that the initiative represents a misguided foray into industrial policy that will backfire over the long term.[27] The more compelling criticisms revolve around future market entry, the ultimate feasibility of establishing a profitable U.S. production base, and the utility of alternative strategies such as pressing harder on the Japanese government or working with Korean and other non-Japanese companies. The basic questions are whether U.S.-controlled mass production of displays in the United States is a

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[25] Ibid., p. VII-2.

[26] U.S. Department of Defense, *Building U.S. Capabilities in Flat Panel Displays* (Washington, D.C.: Department of Defense, 1994), p. VII-3.

[27] These objections are drawn mainly from Claude Barfield, "Flat Panel Displays: A Second Look," *Issues in Science and Technology,* Winter 1994-95, pp. 21-21.

critical enough security need to justify a significant government initiative and whether success is achievable at a reasonable cost.

Although there is insufficient information at this time to answer these questions definitively, and a specific evaluation of DoD's display initiative is outside the scope of this study, it is possible to examine U.S. policy options toward developing advanced display capabilities in light of the dependence issue. Even if Japanese companies were willing to work with DoD, a number of the criteria for evaluating dependence risks—such as the concentration of suppliers and criticality of the technology—imply a high risk. Significant Korean entry and success would alleviate several of the dependence risk factors, but complete dependence on foreign sources for this technology may be unacceptable from a long-term national security standpoint. Although there is a danger that the DoD initiative will not be enough to ensure adequate U.S. capabilities, at about $115 million annually it is a relatively low-risk program that maintains a technological and business option to develop an industry and which may succeed in stimulating the desired critical mass of manufacturing capability. The initiative is also likely to increase DoD's leverage with foreign producers, perhaps stimulating investment in U.S. manufacturing.

Dependence on foreign sources raises a final, more diffuse risk to national security—that capabilities lost in one segment will weaken related sectors, leading eventually to a general downgrading of U.S. technological capabilities in a broad industrial area or that broad industry weakness will adversely affect specific supplier segments that are critical to national security. According to one formulation, manufacturing and technological capability in high-value-added industries has an intrinsic worth to a dynamic economy that is greater than the value of output at a given point in time. Some argue that Japanese technology and industrial policies recognize this dynamic better than those of the United States, leading Japan to emphasize indigenization and nurturing of technological capability.[28]

The trends of the 1970s and 1980s certainly bear out this assertion. For example, loss of U.S. commercial competitiveness in an industry that at first glance appeared to have little security importance—consumer electronics—indeed contributed to the current lack of a U.S. presence in mass production of flat panel displays. The strength of Japanese companies in dynamic random-access memories was leveraged to gain advantages in key areas of semiconductor equipment, such as photolithography. There is some evidence that during the late 1980s individual Japanese companies and production networks utilized practices that are illegal and considered anticompetitive in the U.S. context to pursue their advantage.[29] Concerns were raised about Japanese direct investments in U.S.-high technology companies—in some cases the last remaining companies in their segments. It appeared to some that broad dominance in information-related industries was within the reach of the large Japanese electronics companies.

The situation looks somewhat different in 1995. Today, it is clear that closed production networks and markets and the focus on acquisition and improvement of technology at the

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[28]Richard J. Samuels, *Rich Nation, Strong Army: National Security and the Technological Transformation of Japan* (Ithaca, N.Y.: Cornell University Press, 1994).

[29]"Officials from several government agencies told us that Japanese companies were engaged in tying practices between 1987 and 1989. One agency official stated that his office brought up the issue of tying 9 to 10 times during consultations with the Japanese government and asked the government to encourage Japanese companies to discontinue these practices. This official confirmed that U.S. companies licensed technology to Japanese companies in order to get memory chips." U.S. Congress, General Accounting Office, *International Trade—U.S. Business Access to Certain Foreign State-of-the-Art Technology* (Washington, D.C.: U.S. Government Printing Office, 1991), pp. 43-44.

expense of creating new technology have imposed costs on Japan. For example, if the Japanese computer market had been more open in the 1980s, Japanese companies might have recognized the importance of networked personal computers earlier and adjusted their strategies accordingly. Japan's dominance in DRAMs and resulting large profits attracted new market competition from Korean firms. As U.S. semiconductor and computer companies focused on higher-value-added products and new technologies, many have been able to grow and even establish strong positions in the Japanese market.

However, Japanese companies remain dominant in many areas of the semiconductor and semiconductor equipment industry (Figure 5-1). In the area of lithography equipment, which is critical for semiconductor manufacturing, U.S. producer GCA was forced to shut down in 1993 despite a successful effort to develop superior technology in partnership with SEMATECH. This case illustrates that even when technology policies are effective other policy measures might be necessary to maintain U.S. capabilities. Dependence on Japan affects U.S. space systems integrators as well. For example, NEC and Fujitsu are the only producers of gallium arsenide field effect transistors, which are critical components in space systems.

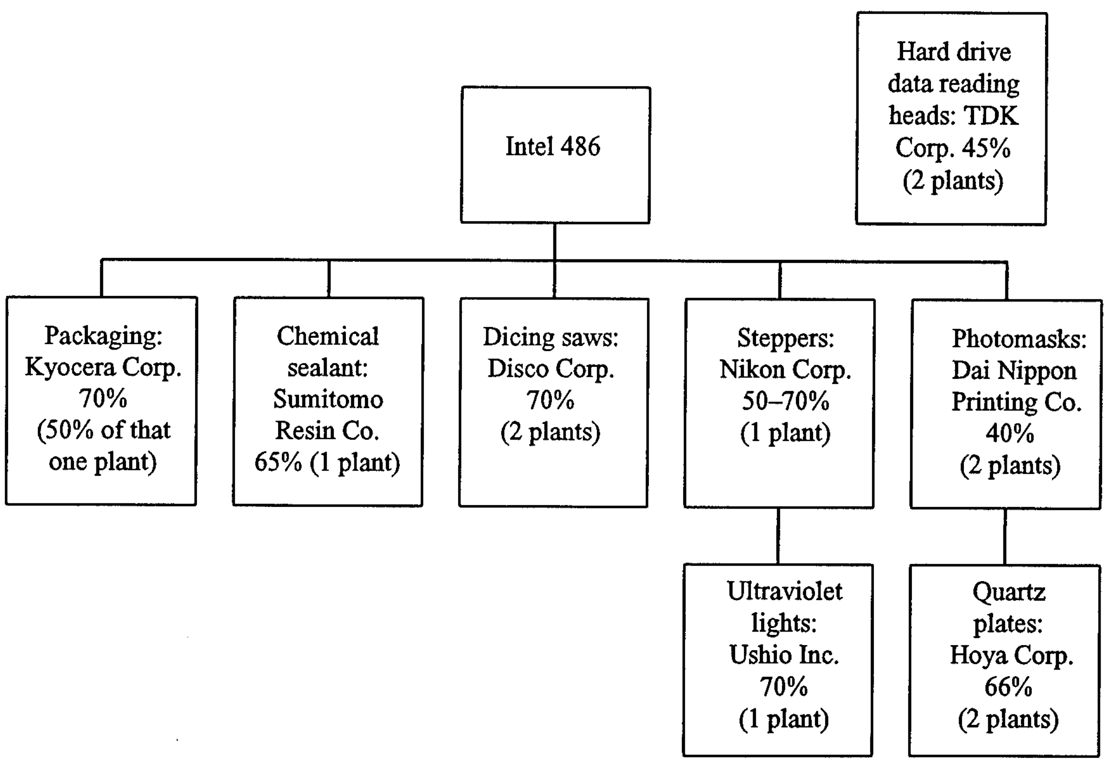

FIGURE 5-1 Typical personal computer supply chain dependencies.
SOURCE: George Gilboy, compiled from *The Wall Street Journal*, August 27, 1993.

Although the rapid erosion of U.S. capabilities in electronics appears to have halted and may even have been reversed in some areas, the United States remains dependent on Japan for a large range of electronics-related technologies and products. It is unreasonable to expect the United States to maintain self-sufficiency in all critical technological areas. The costs of attempting to do so would be staggering. Also, there are advantages to a certain level of interdependence—the United States is able to incorporate advanced foreign technologies into new weapons systems, it may be able to procure components at lower cost, and it can focus resources on potentially more important priorities.

Although some degree of dependence is inevitable, and Japan is likely to remain the most significant source of these dependencies, there are steps that U.S. government and industry can take to effectively manage that dependence and to reduce or eliminate it when necessary for national security purposes. DoD has taken useful steps to subsidize domestic R&D and encourage manufacturing. In the future, more extensive steps might be necessary to ensure a domestic production base in areas where dependence is unacceptable. In areas where dependence on Japan brings substantial benefits with acceptable risks, it might be necessary to pursue specific guarantees from Japanese producers and the Japanese government that U.S. military needs will be met in an emergency.

As for the continuing risk of industrial erosion, DoD's ability to have a major impact is limited. Several of the most important factors influencing overall economic relations, such as trade policy, fall under the responsibility of other agencies. Still, DoD can actively cooperate with other agencies in preserving critical capabilities and by pursuing more reciprocal technology flows in the context of the security relationship, can contribute to creating an atmosphere of mutually beneficial interdependence.

POSSIBLE FUTURE CHALLENGES IN DUAL-USE AREAS

Through licensed production of U.S. military aircraft, Japan has built a manufacturing and technology base that facilitated participation as a key supplier in the global aircraft manufacturing industry, as discussed in Chapter 4. One important dual-use area to single out for future attention because of Japanese policies and current trends is space.

Space will continue to be an important area for development and application of a wide range of broadly applicable technologies, such as propulsion, materials, optoelectronics, energy storage, and systems integration. Space technology is a field in which the United States has consistently led Japan in nearly all dimensions and applications, and the flow of space-related technology has been exclusively from the United States to Japan. American strength in this area stems from the decades-old commitment to space exploration and exploitation.

However, the Japanese space program has gathered momentum in recent years as Japan has sought to develop commercially viable space-related industries. To that end, "Japan has followed in space the strategy that has been successful in other high-technology areas—identifying the leader in technological capability and learning as much as possible from its accomplishments, then building on that learning to develop a strong indigenous technology base."[30] Commercial licensing, technology transfer, and other cooperative projects have helped Japan develop its

[30]John M. Logsdon, "U.S. - Japanese Space Relations at a Crossroads," *Science*, January 17, 1992, p. 294.

capabilities in space technologies more quickly and less expensively than would have been possible otherwise.

U.S.-Japanese collaboration in space has been extensive. In 1968 the two governments agreed that the United States would support Japan in the development of selected space-related technologies and capabilities. For example, Japan was permitted to manufacture Delta launch vehicles. As a result, it was able to acquire an important technology without making massive investments in research and development. Collaboration progressed throughout the 1970s, with Japan acquiring broadcast, meteorological, and communications satellites and assimilating related technologies through joint manufacturing activities. Japanese industry developed a very strong, internationally competitive position in ground stations for satellite tracking and communications during this period.

In 1984 Japan began to move toward privatizing its communications and broadcasting networks. Although satellite systems had been only a small component of its service networks, Japan decided that full-fledged commercial operating systems should be developed. Satellites and launch services would be required to develop such systems, and U.S. firms sought to be included in the supply of hardware and in owner-operated groups. This became a U.S.-Japan trade issue during the mid and late 1980s. With the help of the U.S. Trade Representative and the Federal Communications Commission, American firms were able to gain access to the developing market.

Today, Japan's ongoing and planned space programs are "broad, bold and far-reaching in perspective."[31] Its space programs are overseen by the Space Activities Commission, an advisory body to the Prime Minister, coordinated by the Science and Technology Agency, and undertaken by the Institute of Space and Astronautical Science, the National Aerospace Laboratory, and the National Space Development Agency of Japan. U.S.-Japan cooperation in space programs and technologies has continued at the government-to-government level through Japanese participation in the development of the planned Space Station.

There are several issues related to space development in Japan that U.S. industry and government will need to monitor for the future. The first is the technological trajectory of Japanese and other foreign countries in satellite communications, launch capabilities, and underlying technologies. A recent panel that looked at global developments in satellite communications concluded that in this rapidly expanding field U.S. leadership is being challenged.[32] Although U.S. firms are still the world leaders in most aspects of commercial space activities, Japan has well-funded, long-range research programs to develop advanced indigenous capabilities in satellites and launch systems. The H-II rocket, for example, is a promising advanced launch system, despite some delays experienced in design and testing.

A second issue is the opportunities that Japan might have in the future for developing space capabilities through addressing security needs. Although Japan currently has restrictions on military uses of space, the recent report of an advisory committee to the Prime Minister calls for Japan to develop a system of reconnaissance satellites. If such satellites are used for observation,

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[31]C. L. Merkle, J. R. Brown, J. P. McCarty, G. B. Northam, L. A. Povinelli, M. L. Stangeland, and E. E. Zukoski, *JTEC Panel Report on Space and Transatmospheric Propulsion Technology* (Loyola, Md.: Japanese Technology Evaluation Center, 1990), p. xi.

[32]Burton Edelson, Joseph Pelton, Charles W. Bostian, William T. Brandon, Vincent W. S. Chan, E. Paul Hager, Neil R. Helm, Raymond D. Jennings, Robert W. Kwan, Christoph E. Mahle, Edward D. Miller, and Lance Riley, *NASA/NSF Panel Report on Satellite Communications Systems and Technology* (Baltimore, Md.: International Technology Research Institute, 1993), p. 183.

perhaps performing disaster prevention and weather functions as well as reconnaissance, and do not direct weapons, it might be possible to deploy such a system within the current Japanese policy framework. Further, Defense Task Force members observed during meetings in Japan in November 1994 that there appears to be strong and fairly broad support for such a system. Finally, in contrast to theater missile defense, where much of the Japanese procurement could go toward buying or licensing American equipment, an indigenous reconnaissance satellite system could advance Japan's security goals while providing a bigger boost for industry. Security concerns could justify such a system being procured domestically, in contrast to NTT (Nippon Telephone and Telegraph) and other commercial satellite procurements, which now must be open to international competition as a result of U.S.-Japan trade negotiations.

DoD has singled out control of the use of space as one of five key U.S. war fighting needs for the future.[33] Maintaining a strong, internationally competitive U.S. space industrial base will be necessary to meet this critical need.[34] In addition to Europe, Russia, and China, Japan's future capabilities in space and underlying technologies have the potential to affect U.S. interests in this area.

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[33]DoD, *Defense Science and Technology Strategy*, op. cit., pp. 6-7.
[34]Vice President's Space Policy Advisory Board, *The Future of the U.S. Space Industrial Base*, 1992.

6
Looking to the Future: U.S. and Japanese Needs, Obstacles, and Alternative Approaches

MUTUAL NEEDS

From its examination of trends in the environment for the U.S.-Japan security alliance, U.S. and Japanese needs and capabilities, and the historical experience with various cooperative mechanisms, the Defense Task Force has formulated several conclusions regarding U.S. and Japanese needs in defense and dual-use technology cooperation, as described below.

Japan will almost certainly continue to need U.S. defense systems and desire U.S. defense technology. Japan has licensed produced and procured U.S. weapons systems since the mid-1950s. It is unlikely that this requirement will end or that Japan will embrace one of the conceivable alternatives in the foreseeable future. Although powerful forces in Japanese industry and government will continue to favor a higher level of indigenous capability, a wholesale shift toward Japanese-designed and -built systems is unlikely barring a sudden deterioration in U.S.-Japan relations or another equally significant shift in Japan's security environment. Independent development programs for much of the range of weapons that Japan requires would certainly be possible in light of overall technological and industrial capabilities but would require a defense budget several times larger than the current one to procure less capable systems. The current downward pressure on the Japanese defense budget is likely to continue. Shifts in Japan toward a stronger form of pacifism or moves toward closer cooperation with European defense contractors are also possible but not likely. The possibility of European cooperation might be used in particular cases as a bargaining tactic, as it has been in the past.

Japanese government and industry are likely to continue to seek technological benefits in defense technology cooperation with the United States that will enhance capabilities in both defense and commercial fields. Obtaining the "magic bullet" of systems integration and design capability for large systems through cooperation with the United States and independent weapons programs has been a constant and unfulfilled dream for Japan. Deep strengths in this area have been elusive because the United States has structured programs such that these skills are not transferred to Japan and other licensed production partners and because to a significant degree systems integration skills are learned through experience. Japanese industry will continue to maximize the learning benefits of international cooperation and will seek to incorporate and field indigenous developments to the extent possible.[1]

[1]A recent survey conducted by the MIT Japan Program found that most Japanese defense contractors, particularly the systems and aerospace houses, favor continued cooperation with the United States. The major defense electronics firms were less enthusiastic than the primes, perhaps because they are less dependent on U.S. technology than the primes, and electronic subsystems have been a focus of indigenization efforts in Japan's defense production. See Michael Green, *The Japanese Defense Industry's Views of U.S.-Japan Defense Technology Cooperation: Findings of the MIT Japan Program Survey*, MIT Japan Program, January 1994.

Although Japanese government and industry would prefer indigenous programs or international collaboration that results in a one-way, inward technology flow, a future of constrained defense budgets could make them amenable to more reciprocal U.S.-Japan cooperation. This is particularly true if technology transfer to the United States is structured into collaboration as a necessary element of doing business.

The United States has a continuing interest in furnishing Japan with major weapons systems and in certain aspects of the Japanese defense budget, such as host-nation support. U.S. defense contractors and suppliers are contracting, consolidating, or diversifying in the current climate of declining defense budgets. In the past, export sales and licensed production programs with allies have contributed to maintaining the U.S. defense industrial base by spreading fixed costs and providing additional income for U.S. contractors. Japan is likely to remain a major market for advanced weapons systems. Although potential sales to Japan or other allies should not be a primary driver of what systems and technologies are developed in the United States, prudently managed sales to Japan and other allies can continue to bring benefits to the United States, as they have in the past.

Although Japan has few dedicated defense technologies of interest to the United States, Japanese capabilities are sufficient to allow for more reciprocal technological relationships in collaborative defense programs. Japanese commercial technologies could make a significant contribution to U.S. defense systems, and this potential contribution will rise in the future.

In the judgement of the Defense Task Force, the time has passed when defense cooperation featuring primarily one-way transfers of technology from the United States to Japan could be justified by U.S. security interests. Therefore, to the extent that Japan desires the transfer of U.S. defense technologies, the United States has leverage that can be used to structure more reciprocal relationships.

The United States needs to manage dependencies on foreign sources of critical equipment and components for defense systems. Although the negative trend of increasing dependence in areas such as electronics appears to have abated, at least for the time being, dependence on foreign sources and technologies is a fact of life. Japan is likely to continue to be a major source of these dependencies.

GENERAL PATTERNS OF INTERACTION AND IMPLICATIONS FOR U.S. INTERESTS

From its study, the Defense Task Force believes that there are several possible scenarios for future patterns of U.S.-Japan cooperation in defense and dual-use technology. They are described below in order of their desirability in terms of U.S. interests.

- *In terms of U.S. interests, the most preferred scenario for the future is expanded U.S.-Japan defense technology collaboration featuring reciprocal technology flows within the context of a strengthened U.S.-Japan alliance.* If both governments and industries make a focused, long-term effort to overcome the barriers to cooperation described in this report and summarized below, expanded reciprocal defense technology interaction that helps to meet U.S. and mutual defense needs in the emerging environment is achievable. An enhanced, reciprocal U.S.-Japan partnership in technology to meet defense and security needs could feature cooperation in such areas as upgrading and improving existing systems, adapting commercial technologies to defense

applications, developing new enabling technologies, and perhaps even codevelopment of new systems.

• *An acceptable scenario that would advance U.S. interests is limited U.S.-Japan defense technology collaboration in the context of continued Japanese off-the-shelf purchases from the United States of major systems and a continued strong security alliance.* Particularly if the security environment remains favorable and Japan's defense budget remains constrained, Japan may opt to fill most future defense needs through indigenous development and off-the-shelf purchases. This scenario would be acceptable as long as the United States maintains its current share of Japanese weapons purchases and reciprocal technology flows are structured into less frequent collaborative programs.

• *An unattractive scenario for the United States is a continued pattern of U.S.-Japan defense collaboration featuring a one-way flow of technology from the United States to Japan with growing uncertainty in the security alliance.* Even if U.S. military security interests alone no longer provide a rationale for collaboration involving one-way transfers of U.S. defense technology to Japan, some might argue that such cooperation is worthwhile for other reasons. For example, Japanese licensed production of U.S. systems provides income to U.S. companies and helps amortize U.S. government research and development (R&D) costs, contributing resources that can be reinvested in next generation technologies. Others would assert that one-way licensing deals are necessary in order to compete with European weapons contractors and indigenous Japanese development programs. Although these considerations have some validity and a defense technology relationship characterized by "technology-for-money" might be favored by some interests in both countries, the Defense Task Force believes that pursuing such an approach could undermine good relations and would not serve the long-term interests of either country.

In the long run, the U.S.-Japan alliance will be best served by defense technology collaboration that can stand close scrutiny and attract sustained support from the political leadership and broader publics of both countries. To build continued support for collaboration involving transfer of U.S. technologies to Japan—which inevitably also involves potential commercial risks for U.S. companies and opportunities for Japanese industry—it will be necessary to show that the United States is gaining similar opportunities to benefit from cooperation.

• *The worst-case scenario in terms of U.S. interests would be a contentious U.S.-Japan defense technology relationship that erodes the overall security alliance or worse.* This scenario could come to pass if barriers to cooperation cannot be overcome and the interests of both countries diverge due to changes in the security environment.

OBSTACLES TO COOPERATION AND POLICY OPTIONS

Asymmetries in Capabilities and Institutions

Obstacle: *Asymmetries in capabilities and institutions for technology and industrial development, leading to differences in preferences regarding cooperative mechanisms.*

These basic asymmetries were discussed and documented in Chapter 3. The disparity in capabilities in dedicated defense technology is the most serious asymmetry. As long as Japan focuses only limited resources on defense technology, this basic asymmetry is likely to remain.

Largely as a result, U.S. and Japanese government and industry have traditionally displayed very different preferences regarding cooperative mechanisms. Other things being equal, U.S. government and industry would prefer to sell U.S. systems to Japan off the shelf. Japanese industry and government would prefer indigenous development. In the past, licensed production often served as a compromise between these preferences. However, one-way licensing is no longer advantageous for the United States. Over the past 10 years several new mechanisms have been tried, but the results have been disappointing.

However, as discussed in Chapter 5, the United States is moving in the direction of greater utilization of the commercial technology base, particularly in areas where Japanese industry possesses advanced capabilities. If this trend continues, it should serve to somewhat ameliorate the basic U.S.-Japan asymmetry in dedicated defense technology.

In this environment the imperative will be to make patient efforts to lower or remove barriers to existing and new collaborative mechanisms that would enhance reciprocal technology flows. One long-standing issue is the interpretation and enforcement of Japan's arms export controls (see Box 4-3).

***Option**: Seek a clarified interpretation and modification of Japan's arms export control policy that facilitates enhanced interaction.* Japan's continued adherence to its ban on arms exports is consistent with U.S. interests. A general lifting of the ban would not be in U.S. interests. But at the very least the current situation surrounding interpretation and enforcement requires clarification. As outlined above, problems arise in two contexts: (1) when lack of clarity in interpretation serves to prevent Japanese commercial technologies from being incorporated into U.S. defense systems and (2) when joint R&D on new subsystems and upgrades is dampened by the reexport provisions on allowable transfers of Japanese defense technologies to the United States.

In a number of cases that have become public knowledge or have come to the attention of the Defense Task Force, U.S. companies were informed by Japanese counterparts that components utilizing essentially commercial technology could not be exported for use in U.S. defense systems due to the export ban. In those situations the Japanese company is generally reluctant to license the technology out of concern for possible future commercial competition. Without clarification, there is no easy way for U.S. companies to confirm that such a component export would actually be restricted. These cases do not receive wide attention because the U.S. companies involved are reluctant to raise the issue publicly. As major U.S. defense contractors, they may have extensive business interests in Japan's defense and commercial markets and are justifiably concerned about retaliation.

One way to address both issues would be to seek from Japan an exception to the three principles for the United States, which would allow export of weapons and components only to the United States. An exception for the United States already exists for allowing the export of defense technologies, but it has not led to significant technology transfer. The Defense Task Force considered this approach but believes that such a change might not result in an expanded flow of technology to the United States and might introduce new complications into the relationship.

The Defense Task Force believes that there is much to recommend an alternative, two-pronged approach. First, to address the issue of expanding U.S.-Japan industry relationships that lead to incorporation of embedded Japanese technology into U.S. weapons systems, the United States should seek a clarification in Japan's arms export principles to clearly allow minor modification of substantially commercial technologies for specific defense applications. A component using essentially commercial technology that undergoes minor modifications for utilization in a U.S. military system would not appear to be subject to the spirit of the ban. If the Ministry of International Trade and Industry and the Japan Defense Agency (JDA) could make a public statement to that effect, it could facilitate greater U.S.-Japan collaboration.

Second, to provide a greater incentive to collaborate in upgrading systems and subsystems, the United States should seek a change to the 1983 memorandum of understanding (MOU) that allows export of Japanese defense technology to the United States so that these technologies are exempted from reexport restrictions. Since any reexported subsystems would be manufactured in the United States, Japan would not be exporting weapons. Provisions would need to be made for payment of royalties on these technologies to Japan.

Changes in Japanese policies related to international defense technology cooperation, including the export control policies, are under active discussion in Japanese business and policy circles.[2]

Japanese Government and Industry Attitudes

Obstacle: *Unwillingness of Japanese industry and government to cooperate technologically on reciprocal terms.*

The Defense Task Force believes that this is a real and challenging barrier, but there are signs that it is not intractable, given proper incentives. The acquisition and improvement of technology have been key features of Japan's economic development and the growth of individual companies. For Japanese companies, technology has historically been a scarce and valuable commodity—worth going to great lengths to acquire and certainly not to be sold cheaply or perhaps at all. The task force considered various incentives to encourage a more forthcoming attitude on the part of Japanese government and industry.

Option: *Encouraging U.S.-Japan industry collaboration in developing enabling technologies for future defense systems through a joint program of R&D grants.*

This approach aims to build on several positive examples described in the report in developing new incentives for effective reciprocal U.S.-Japan collaboration in defense and dual-use technologies. Both the United States and Japan are rethinking the missions and force structures of their military services in an environment where R&D needed to generate the technology base for new systems will be more difficult to support because of lower production rates and longer development cycles. Both the U.S. government and private companies will likely be more reluctant to invest in unique military R&D and more interested in utilizing dual-use technology.

At the same time, the U.S. government will increasingly insist on teaming companies in the development of new weapons systems, as in the case of the F-22. In some respects this implies

[2] Japan Federation of Economic Organizations, "A Call for a Defense Program for a New World Order," (provisional translation), May 1995.

convergence toward aspects of Japan's procurement practices, in which major contractors are generally guaranteed a piece of all major systems. As defense companies become increasingly proficient in managing collaborative systems development under conditions of intense global competition, there is a stronger rationale for collaborative R&D on enabling technologies to leverage resources and spread risk.

This rationale applies in the U.S.-Japan context as well, as has been discussed. Building closer and more effective U.S.-Japan industry-to-industry relationships will likely require a persistent effort. Launching a program of joint industry-to-industry R&D would institutionalize industry involvement and cooperation and would help build working relationships for possible future joint development programs. Competition for government funding of this joint R&D would also be an excellent test of whether companies in the two countries are really interested in working together. The MARITECH program discussed in Appendix B appears to be facilitating U.S.-Japan industry relationships that enhance reciprocal technology flows.

U.S.-Japan joint R&D in enabling technologies for future weapons systems could be a useful focus for such a program. This would position the partners involved to feed those technologies into future systems and could lay the groundwork for possible U.S.-Japan collaboration in developing systems or subsystems. Because of the limited production base associated with purely military products, companies might be reluctant to undertake joint programs unless there is an opportunity for commercial market benefit from the technology that has been developed. To bridge this obstacle, the participating companies could be allowed to utilize the results of the research in their commercial businesses in return for cost sharing in the R&D program.

Such a program could be launched, perhaps through the Systems and Technology Forum, as an effort of both governments to fund four or five joint industry projects. DoD and JDA would jointly request and evaluate proposals from teams of U.S. and Japanese companies that address common future system or subsystem needs.

Bilateral and U.S. Government Approaches

Obstacle: *Lack of consistency and coordination in U.S. government approaches.*

Appendix A summarizes Defense Science Board reports issued in 1984 and 1989 to evaluate U.S.-Japan collaboration in defense technology and recommend changes in U.S. policy. Although a few of the broad recommendations have been implemented, several of the specific suggestions regarding DoD policies and organization have not been acted upon. It is clear to the Defense Task Force that a persistent coordinated effort by DoD in cooperation with other agencies and U.S. industry will be necessary to advance U.S. security interests in science and technology relations with Japan in the future.

There are two related imperatives. The first is to ensure that the pursuit of technology reciprocity and related benefits is built into the overall management of the U.S.-Japan security relationship. The second imperative is to ensure effective coordination and management of specific collaborative programs, with technology reciprocity issues receiving focused attention from an early stage.

Option: *To ensure that the U.S.-Japan security relationship is maintained and strengthened, establish a U.S.-Japan comprehensive security dialogue that features an integrated discussion of the political-military, economic, technological, and other aspects of the alliance.*

As this report has outlined, the environment surrounding the U.S.-Japan security alliance has changed dramatically in recent years. Both allies are in a process of reassessing security policies and priorities. Although the established consultative mechanisms have continued to function relatively well and the United States has launched two security-related policy initiatives with Japan—the Technology-for-Technology (TFT) initiative and recent discussions on enhancing defense and security cooperation (known as the Nye or Lord-Nye initiative)—there has not been a systematic effort to exchange perspectives on possible restructuring of roles and missions in the overall relationship.[3] Just as enhanced reciprocal U.S.-Japan cooperation in defense and dual-use technologies could serve to strengthen the alliance for the future, continued vitality in the overall alliance will be necessary to build new structures for technology cooperation.

In light of the continuing importance of the U.S.-Japan alliance, changes in the environment surrounding the alliance, the evolving strategies of the partners and uncertainties about future challenges, the Defense Task Force believes that now is the time for an expanded forward looking U.S.-Japan dialogue on fundamental issues. In light of continuing economic frictions and observed U.S.-Japan differences in perspective on several important issues, a comprehensive security dialogue could make an important contribution to smooth alliance management over the next few years. A U.S.-Japan comprehensive security dialogue would build on recent and ongoing official exchanges. Ideally, it would be launched after the completion of the current Lord-Nye initiative, which is being undertaken at the working level and is focused on nuts-and-bolts issues of security cooperation.

The Defense Task Force believes that a U.S.-Japan comprehensive security dialogue could make a positive contribution in several areas. The first goal would be to establish a common understanding of mutual interests for a vital U.S.-Japan security partnership appropriate to post Cold War realities. This would involve an integrated discussion of key security issues such as roles and missions in the alliance, enhanced defense and dual-use technology cooperation, the implications of security policy changes in each country (such as possible revision of the National Defense Program Outline in Japan) and the evolving role of the U.S.-Japan alliance in Asia-Pacific security.

One option for achieving such an integrated security discussion would be to follow the Lord-Nye initiative with a broader dialogue coordinated at the cabinet or deputy secretary level. Such an approach could have value, but the Defense Task Force believes that a comprehensive security dialogue can and should try to do more. Although the specifics of security cooperation in areas such as ensuring host nation support and resolving issues related to U.S. military bases in Japan are important and deserve focus, the long term importance of the alliance goes beyond the particulars of security cooperation, including the defense technology issues that are the focus of this report. The comprehensive security dialogue could catalyze deeper thinking about the long-term rationale and role of the alliance than has been apparent in either country recently. A highly visible U.S.-Japan comprehensive security dialogue would also signal to Asia-Pacific countries that the two largest economic powers in the region and the world recognize that an effective bilateral partnership is essential to continued stability and development in the region, and would contribute to the development of regional security initiatives and national policies along constructive lines.

[3] On the Lord-Nye initiative, see Joseph S. Nye, Jr., "Leadership and Alliances in East Asia," Speech at the Japan Society, New York, May 11, 1995.

A further purpose of the U.S.-Japan comprehensive security dialogue would be to integrate discussion of the political-military, economic, technological, and other aspects of the alliance. Although economics and security will inevitably continue to be managed along separate tracks day-to-day, the Defense Task Force believes that it is important for the leadership and broader publics of both countries to understand that trends and developments in one area inevitably influence attitudes and context in other areas. It is unrealistic to believe that a "firewall" can be maintained long term to protect one aspect of the relationship from significant erosion of goodwill in others. In order for the comprehensive dialogue to integrate various aspects of the relationship, it should include participation from agencies in both countries responsible for economic and technological relations in addition to those responsible for defense and foreign policy.

It is important that the comprehensive security dialogue have official sanction at a high level yet be nonbureaucratic and flexible. Ideally, it would be coordinated by special designees of the president and the prime minister. Unlike current consultative mechanisms, the comprehensive security dialogue should bring in active participation and new thinking from the industrial and academic sectors of both countries.

The Defense Task Force does not believe that this possible comprehensive security dialogue is a panacea or magic formula that would resolve all the uncertainties and frictions in the U.S.-Japan relationship. In the late 1970s, President Carter and Prime Minister Ohira established the "Wisemen's Group" as a forum for enhanced discussion of economic issues at a time when bilateral frictions were growing, and this forum made important contributions over the time it was in existence. The Defense Task Force believes that the alliance stands at a more critical juncture now than it did at that time, and that even the modest achievements that might be expected from a comprehensive security dialogue could be important and very timely.

From the point of view of the Defense Task Force, the key desirable features of the comprehensive security dialogue outlined here would be its high level mandate and independence from bureaucratic agendas, the integrated discussion of all aspects of the relationship, and active participation across agencies and from the private sectors of both countries. Should the U.S. and Japanese governments agree that a comprehensive security dialogue would be desirable, they could work out the specifics of the activity, including whether it should have a fixed length, whether it should issue reports and what links it should have to day-to-day policymaking.

***Options** for improving U.S. government coordination to maximize U.S. interests in U.S.-Japan collaborative programs.*

In its 1989 report titled *Defense Industrial Cooperation with Pacific Rim Nations*, the Defense Science Board (DSB) task force recommended major organizational changes for the DoD. The DSB argued that the experience with the FS-X negotiations showed that the U.S. government was not organized to effectively pursue international defense industry collaboration in an environment where policymaking and management increasingly require the traditional goals of technology security and security assistance to be integrated with concerns about the economic impacts of technology transfer and opportunities for pursuing reciprocal technology flow. Specifically, the DSB recommended consolidation of the Defense Security Assistance Agency, the Defense Technology Security Administration, the then Office of the Deputy Under Secretary of Defense for Industrial and International Programs, and the Office of the Director of International Acquisition into a single new agency.

DoD has recently undertaken some reorganization relevant to these issues, including the establishment of an Assistant Secretary for Economic Security, a new Deputy Under Secretary of Defense for Acquisition Reform, and a Defense Industrial Base Oversight Council. It is unclear whether these changes are adequate to provide the required level of focus and coordination in future collaborative programs.

The imperative for pursuing initiatives and relationships with Japan in an integrated strategic manner will be even more important in the future, particularly in connection with possible future U.S.-Japan cooperation in large systems. One current example is theater missile defense (TMD). Although Japan will likely not decide whether to field a system immediately, the Defense Task Force believes that now is the time for DoD, along with the military services, other U.S. government agencies, and U.S. industry, to begin developing a coordinated approach to the following issues: (1) desired technological contributions from Japan that are possible within the context of TMD cooperation, as well as Japanese technologies that could be transferred to meet other U.S. defense needs in return for U.S. TMD-related technologies that might be transferred to Japan; (2) U.S. TMD-related technologies that need to be protected in a collaborative program; and (3) parts of the TMD system that could be license produced in Japan. The Defense Task Force is well aware of the significant obstacles to effective coordination in defense and security policymaking and is wary about making specific recommendations to DoD in this area. However, the need is so pressing and timely that consideration of new approaches is well justified.

One alternative would be a major reorganization along the lines of earlier DSB recommendations. Although such a reorganization could be useful, it would disrupt ongoing operations and incur the risks of not achieving the desired goals or of introducing new complications.

The second alternative is appointment of a responsible point of coordination on a case-by-case basis for major systems in which collaboration with Japan or other nations is under discussion or is a strong possibility, as TMD is today. This is perhaps a minimum requirement for effective management, but such a coordinator would not guarantee success. If the person appointed is too high ranking, he or she might not be able to devote sufficient attention to the task. A lower-ranking official would be subject to the same sorts of crossfire from various constituencies that might occur even without coordination. However, a single point of coordination would ensure consideration of all the relevant issues at an early date and would help to ensure a common front in discussions with Japan and other allies.

A third alternative, which might become necessary in the future if the level of activity in international defense technology cooperation rises, would be a formal coordinating mechanism better linking current organizational structures. To draw an analogy, a major effort is currently being undertaken to coordinate the acquisition agendas of the services through the Joint Requirements Oversight Council. Should conditions warrant it, DoD might consider establishing a parallel International Programs Coordination Council to coordinate the agendas of the relevant parts of DoD and the services for international defense industry and technology programs that are under consideration or discussion.

7
Maximizing U.S. Interests: Conclusions and Policy Recommendations[1]

CONCLUSIONS

Importance and Context of the U.S.-Japan Alliance

A strong U.S.-Japan security alliance continues to serve the fundamental interests of the United States and Japan. The alliance contributes to advancing U.S. interests in the Asia-Pacific region and the world, such as ensuring stability in the region and preventing the rise of a hegemonic power. For Japan maintaining its alliance with the United States is a vital interest because it provides a strategic umbrella, substitutes for a much more expensive independent defense capability, and facilitates friendly relations with its Asian neighbors. The United States continues to have a great deal of leverage in the relationship, which can and should be used to advance U.S. technological and other interests.

The Role of Science and Technology

Science and technology will continue to play an important role in the U.S.-Japan security relationship, but this role will be different than it has been in the past. The United States has a continuing interest in furnishing Japan with major weapons systems and in aspects of the Japanese defense budget, such as host-nation support. However, the Defense Task Force believes that the time has passed when defense cooperation featuring primarily one-way transfers of technology from the United States to Japan could be justified by U.S. security interests. In order for U.S.-Japan cooperation to advance U.S. interests in the future, it must feature greatly expanded Japanese technological contributions to meeting U.S. and common defense needs.

Japanese Defense and Technological Needs

The Defense Task Force believes that Japan's government and industry will continue to seek access to foreign technological capabilities to support its defense needs; will continue to maximize the commercial benefits of defense technology and manufacturing activities, including international collaboration; and will continue focused efforts to upgrade international competitiveness in areas of defense-commercial spinoff such as commercial aircraft, space (both launch and satellites), and applications of advanced computing and electronics.

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[1]The purpose of this chapter is to present the conclusions and recommendations in a concise way. Further discussion of the reasoning behind the conclusions and recommendations, including consideration of alternative approaches considered by the Defense Task Force, is provided in Chapter 6. The Executive Summary presents the highlights of the conclusions and recommendations within the context of the entire study.

U.S. Interests in Japanese Technology and Reciprocity

The Technology-for-Technology (TFT) initiative that has been pursued by the U.S. Department of Defense (DoD) articulates an important principle: no significant transfers of U.S. military technology to Japan without a reciprocal flow of Japanese technology to the United States. Japan has had only limited indigenous capabilities in dedicated defense technology. Japanese technologies, particularly commercial technologies, could make a significant contribution to U.S. defense systems, and this potential contribution will rise in the future. However, a number of barriers prevent an optimal flow. Even though an evenly balanced flow is perhaps not possible in the foreseeable future, greater reciprocity must be pursued. A persistent long-term effort will be required to build a more balanced U.S.-Japan technology relationship.

Results of Past Efforts

Despite several U.S.-Japan agreements and DoD initiatives over the past 15 years, transfer of both military and commercial technologies from Japan to the United States to support U.S. national security has been minimal.

Japanese Industry and Government Roles

Although some Japanese groups have expressed support for the TFT initiative, there has been no strong constituency in Japan for expanded technology transfer to the United States—in defense or commercial areas. The Defense Task Force believes that ongoing changes in the environment should lead to greater incentives for cooperation on both sides. Still, without recognition on the part of Japanese government and industry that reciprocal technology relationships will strengthen the alliance—and thereby serve Japan's interests—results will be very difficult or impossible to come by. This could erode the alliance in the long term.

U.S. Industry and Government Roles

U.S. industry needs to be intimately involved in building overall strategy toward technology relationships with Japan and in planning U.S.-Japan collaboration in major systems. Although increased sales, rather than technology acquisition, have been the main goal of U.S. defense companies collaborating with Japanese industry, this report documents a number of specific Japanese technologies and broad areas of technical achievement of interest to U.S. industry. However, national strategy cannot be built around the specific technological needs of U.S. companies for two reasons: (1) the strongest U.S. companies can often pursue their interests by themselves, and (2) some U.S. companies may find it difficult to apply Japanese technologies developed for high-volume consumer markets to lower-volume defense applications. The larger context is that transfer and application of Japanese technologies are in the broader national security interest. Therefore, the effort to achieve greater reciprocity in this area cannot be solely industry led. U.S. government initiative and leadership will be necessary to achieve real results.

Managing Collaboration in Major Systems

A coordinated strategic approach to possible U.S.-Japan collaboration in future systems must be developed and refined by the United States prior to bilateral negotiations. The appropriate lessons need to be extracted from the FS-X experience and applied to future cooperative programs. Although industry-to-industry relationships have gone smoothly in the development phase, strains were put on the alliance during the FS-X negotiations. DoD and other responsible agencies need to ensure that this experience is not repeated.

Managing Dependence

Despite a recent resurgence by U.S. industry in electronics and several other high technology sectors vis-à-vis Japan, there is no indication that dependence on Japan for a number of critical components and production machinery has decreased significantly. Foreign sourcing, including dependence on Japan, will be a long-term fact of life. Since U.S. defense acquisition policy is moving in the direction of higher reliance on commercial technologies and components, the long-term trend of increased foreign sourcing and dependence is likely to continue and perhaps accelerate. A focused effort is needed to manage this dependence in order to ensure U.S. access to critical technologies and products.

POLICY RECOMMENDATIONS

Reducing and Eliminating Barriers to Cooperation

The Department of Defense should pursue technology reciprocity in the defense relationship with Japan as a major goal. Efforts to increase Japanese technological contributions to U.S. national security should focus on reducing the barriers on the supply and demand sides identified in this report.

The U.S. government should seek to reduce or eliminate barriers to technology flow that result from Japanese policies. Japan's continued adherence to its arms export control principles is consistent with U.S. interests. However, specific factors in interpretation and implementation have constituted barriers to greater Japanese technological contribution to U.S. national security. *The United States should seek from the Japanese government (1) a clarification of the arms export principles and a public statement to the effect that export of items embodying substantially commercial technology that undergo minor modifications for defense applications are not restricted and (2) a change to the 1983 exchange of notes stating that Japanese military technologies transferred to the United States are exempt from retransfer restrictions, with changes addressing legitimate Japanese concerns and including provisions for the payment of royalties.*

The Department of Defense should develop new mechanisms for facilitating technological collaboration between U.S. and Japanese companies to address common defense needs. One promising approach would be a program to fund U.S.-Japan industry research and development (R&D) on specific enabling technologies—including the adaptation of commercial

technologies—targeted at applications in future weapons systems. This could perhaps be undertaken as an extension of the Systems and Technology Forum. This program should be jointly funded and managed by the two governments, possibly with cost sharing by U.S.-Japan industry teams, and should begin with sufficient funding to support four or five individual projects.

Integrating Enhanced Technology Cooperation and Alliance Management

The United States and Japan should initiate a comprehensive security dialogue featuring an integrated discussion of the political-military, economic, technological, and other aspects of the alliance. To maximize the benefits of this dialogue it should (1) be coordinated by special designees of the president and prime minister, (2) establish a common understanding of mutual interests for a vital U.S.-Japan security alliance appropriate to Cold War realities, including roles and missions, defense capabilities and enhanced reciprocal technology cooperation, (3) incorporate discussion of economic as well as political-military issues, and involve the agencies responsible for managing the economic relationship, and (4) include active private-sector participation on both sides.

Organizing to Maximize U.S. Interests

The Department of Defense should ensure a coordinated approach in future collaborative defense programs with Japan. The imperatives are to achieve greater continuity in U.S. policies and implementation, to achieve coordination in pursuing various U.S. interests, and to build strategies for implementation and reciprocal technology flow before bilateral negotiations are launched. One approach that might be adopted as a minimum is designating a single authority with the responsibility for coordinating strategies toward major systems in which collaboration with Japan is under discussion. In the future if the level of international collaborative activities warrants it, DoD might consider a more formal mechanism such as an International Programs Coordinating Council analogous to the Joint Requirements Oversight Council.

The Department of Defense, in cooperation with the Department of Commerce and other appropriate agencies, should continue to build capabilities to monitor and manage dependence on foreign sources of critical technologies, with the goal of ensuring U.S. access. The correct approach to managing this dependence will vary according to the situation. For example, where a high reliance on Japanese sources brings benefits without undue risks, it may make sense to pursue explicit understandings with Japanese industry and government to ensure that U.S. defense needs are met during contingencies. In other cases it might make sense to encourage Japanese sources to establish a U.S. manufacturing facility or to collaborate with U.S. companies. In cases where access to Japanese technologies cannot be ensured, steps could be taken to build a competitive U.S.-owned and -based capability.

Appendix A

Summary of Past Studies on U.S.-Japan Defense Technology Cooperation

BACKGROUND

During the 1980s, the Defense Science Board (DSB) conducted several studies analyzing international cooperation in the research, development, and production of weapons systems and military technologies. The first report, *International Coproduction/Industrial Participation Agreements*, centered on the U.S.-NATO cooperative relationship and was released in August 1983. The follow-up report, *Industry-to-Industry International Armaments Cooperation, Phase II—Japan*, was released in June 1984 and addressed similar themes with respect to Japan. A third study, *Defense Industrial Cooperation with Pacific Rim Nations*, was published in October 1989 and represented an attempt to update the earlier reports and integrate growing economic and competitiveness concerns into the policy planning process.

DEFENSE TECHNOLOGY COOPERATION WITH EUROPE AND JAPAN

The original NATO and Japan studies were chartered by the U.S. Department of Defense (DoD) in 1981 to address issues related to international arms collaboration programs, which were becoming increasingly common. DoD planners recognized that the rationale for collaborative initiatives between the United States and its NATO and Japanese allies had changed and that a new policy framework and criteria for assessing programs were needed.

The first major cooperative armament ventures between the United States and its allies were in the late 1950s and early 1960s, when American fighter aircraft and antiaircraft missiles were coproduced in Europe and Japan. These arrangements were perceived to have distinct advantages for the security of the United States and its allies, including providing modern equipment to allied forces, enhancing standardization, establishing second production sources, and tying coproducers to the U.S. militarily. The coproducers themselves were often motivated by economic factors, including the generation of employment, creation of a defense industrial base, acquisition of advanced technology and management techniques, and improvement of their balance of payments. Cooperative arrangements therefore became common throughout the 1960s and 1970s, encompassing a wide variety of weapons and components.

By 1983, however, international arms collaboration programs had created certain dilemmas for U.S. policymakers. The NATO and Japan studies sought to reexamine and redefine U.S. interests as they related to coproduction and codevelopment. European defense industries had matured, and European military technology was comparable in many respects to that of the United States, which at least in principle, allowed for a two-way flow of technology. The difficulties associated with the Japanese relationship were more complex. While the bilateral

relationship with Japan was accepted as extremely important, cooperative arrangements between the United States and Japan had evolved differently than those with Europe. There was no established policy or overarching framework for technological cooperation with Japan, which NATO provided for Europe. In general terms the DSB task force was concerned with the lack of a cohesive overall U.S. strategy toward Japan that would integrate defense and economic interests.

One of the primary conclusions of the 1984 DSB study was that, although Japan might become a competitor for defense exports, the strategic value of closer cooperation outweighed the potential drawbacks of competition. It was believed that Japan would develop the capability to become a major defense exporter within 10 to 15 years, especially in aerospace technologies. Therefore, technological cooperation with Japan could prove costly in the long run. However, the importance of the bilateral relationship was paramount, and defense technology cooperation was seen as a means to strengthen that relationship. The DSB task force added the reservations that any initiative for cooperation must involve a two-way flow of technology, must serve the U.S. national interest, and must be integrated into a broader economic and security policy toward Japan.

The DSB task force recognized that Japan had developed comparable or superior technologies in several fields. While it believed that few of Japan's narrowly defined military technologies were of interest, certain commercial and dual-use technologies could prove extremely valuable to U.S. defense industries. However, no comprehensive assessment of Japanese technology had yet been made, and it was believed that the United States knew relatively little about Japanese achievements and capabilities in most fields.

The DSB study advocated a "positive but tough approach" toward defense technology cooperation with Japan. Efforts should be broadened, but the United States should maintain a firm requirement of reciprocity and develop a means to assess the balance of technology exchange. Industry-to-industry initiatives were to be encouraged so long as they served national interests. The DSB task force recommended codevelopment of two significant military subsystems to gain experience with the difficulties and benefits of cooperation, with a DSB group meeting periodically to evaluate the net value of ongoing initiatives.

With regard to Japanese technology, the task force recommended initiation of a comprehensive program to rapidly translate Japanese technical and policy documents. It also suggested the application to Japan of recommendations made in the earlier NATO study. These included a presidential policy declaration that the United States was committed to global leadership in important military and commercial technologies, and a commensurate increase in national investment in defense and civilian research and development (R&D). The task force suggested that DoD initiate a comprehensive interagency study on an overall economic and defense strategy.

DEFENSE TECHNOLOGY COOPERATION WITH THE PACIFIC RIM

The 1989 DSB study on cooperation with Pacific Rim nations constituted a follow-on to the earlier NATO and Japan reports. First meeting in March 1988, the Pacific Rim task force sought to update those reports and incorporate increasingly important economic considerations. It also recognized the continued importance of defense technology cooperation. The stated U.S.

objectives for cooperation were essentially similar to those outlined in the earlier reports—increased interoperability and standardization, an enhanced overseas logistics base, reduced duplication and R&D costs, and strengthened allied capabilities through the sharing of advanced weapons and military technology.

However, the task force also identified concerns related to defense industrial cooperation, which were largely understated or dismissed in the earlier studies. The 1989 report clearly recognized a decline in U.S. manufacturing competitiveness and technological superiority and sought to closely link economic and military security. Specifically, the task force cited a "lack of balance in many defense industrial cooperation arrangements where U.S. military gains have sometimes entailed economic penalty."

The major findings of the 1989 DSB study concerned the changed economic relationship between the United States and its Pacific Rim allies and the impact of this change on security concerns. The task force concluded that national and international developments had overtaken existing policies and that a thorough review was necessary. Contemporary U.S. policies were oriented toward NATO armaments *assistance* and were inadequate for actual technological *cooperation* with Pacific Rim countries.

The task force was critical of the strategic planning of U.S. defense industries. It found that U.S. firms often engaged in technology transfer in pursuit of narrow, short-term company goals and without regard for national or industry-wide interests. In addition, U.S. firms underinvested in long-term R&D and failed to take advantage of foreign science and technology, especially Japan's. The task force felt that addressing these issues would improve the overall balance of technology flow.

The 1989 study drew several conclusions from the FS-X experience. It was felt that the FS-X controversy dramatized the need for an integrated strategy combining technology, economics, and security. The United States needed to take a pragmatic approach to cooperation, carefully considering long-term mutual benefits and recognizing the importance of dual-use technologies and their likely impact on the U.S. technology base. The active participation of Congress and several executive branch agencies was deemed necessary to develop broader, more coherent policies.

The task force's recommendations were broken into two categories—policy and managerial. With regard to policy, it was suggested that the Office of the Secretary of Defense (OSD) and the National Security Council establish a high-level group that would work to link defense and economic interests as they related to cooperation. Similarly, it was recommended that OSD develop a broad, long-term national technology vision to be formalized and implemented through a presidential statement. The task force felt that the United States should only participate in cooperative initiatives that were mutually beneficial (reciprocal) and clearly served both security and economic interests. Finally, the study recommended greater cooperation in basic science and technology collaborative projects, possibly in coordination with the National Science Foundation.

With regard to managerial issues, the DSB recommended (for the third time in as many administrations) a series of reorganizations the would seek to change the policy emphasis from defense industrial assistance to cooperation. The task force recommended that DoD develop a more structured cooperative framework for interacting with Pacific Rim nations and evaluating cooperative ventures and that several small demonstration projects be initiated. It was suggested that industry take the lead in initiating cooperative projects. Finally, the task force recommended

the declaration of global leadership in defense and commercial science and technology as a national goal and that the United States should make the R&D investments necessary to meet this goal.

Common Themes

The 1984 and 1989 DSB reports made many similar recommendations (see Table A-1). The reports shared the same fundamental conclusion—the United States must insist on a more balanced flow of technology when cooperating with its allies. The primary difference was the 1989 report's heavy emphasis on commercial competitiveness and economic well-being. This emphasis allowed the Pacific Rim task force to make more specific and focused recommendations regarding future defense technology cooperation.

Follow-up to the Defense Science Board Studies

To a large extent, the recommendations of the two DSB studies were not implemented. Recent administrations have issued statements on the importance of U.S. technology leadership and have launched initiatives to encourage technology investments by industry.[1] However, a number of the specific recommendations related to U.S.-Japan cooperation have not been acted on. DoD has reorganized somewhat but not to the extent recommended in the 1989 study. A clear policy for integrating economic and security interests in defense collaboration has not been issued.

[1]President William J. Clinton and Vice President Albert Gore, Jr., *Technology for America's Economic Growth: A New Direction to Build Economic Strength*, 1993.

TABLE A-1 Recommendations Specific to Both Defense Science Board Reports Related to Defense Technology Cooperation with Japan

Industry-to-Industry International Armaments Cooperation, Phase II–Japan (1984)	*Defense Industrial Cooperation with Pacific Rim Nations (1989)*
President should declare technological superiority a national goal.	The United States should develop a national technology vision to be implemented through a presidential statement.
DoD should invest in research and development to meet national goal.	The U.S. government should emphasize commercialization of technology and technical education and provide incentives for industrial investment in critical technologies.
The Under Secretary of Defense for Research and Engineering should develop means for assessing the balance of technology exchange and the overall benefit.	The Under Secretary of Defense for Acquisition should establish procedures and guidelines to achieve stated mutual benefits from cooperation consistent with security and economic concerns.
DoD should make a joint high-level statement with the Japanese government encouraging industry-to-industry technology cooperation.	DoD should encourage industry-to-industry collaboration, and consult with industry before and during negotiations on program memoranda of understanding.
DoD should stimulate the initiation of a comprehensive interagency study on overall defense/economic strategy.	The Secretary of Defense and the National Security Council should establish policy and evaluate defense/economic linkages and trade-offs related to cooperation.
The United States and Japan should expand cooperation in basic research.	The Under Secretary of Defense for Acquisition should coordinate increased cooperation in basic research with National Science Foundation programs.
The United States and Japan should undertake codevelopment of two significant subsystems to gain experience.	DoD should initiate several small programs with Pacific Rim countries to serve as models.

SOURCE: Compiled by Office of Japan Affairs staff.

Appendix B

Japanese Technology and Efforts to Rebuild U.S. Commercial Shipbuilding: The Newport News Shipbuilding-Ishikawajima Harima Heavy Industries Alliance

BACKGROUND

Rapidly changing political and economic environments are causing many U.S. defense firms to alter their approach to technology acquisition and cooperation. As they seek to enter new markets and offset the decline in revenues from defense contracts, American companies are faced with strong international competition and have become increasingly interested in foreign technology.

One such firm is Newport News Shipbuilding and Drydock Company, a leading builder of naval vessels. Founded in 1886 and now part of the Tenneco conglomerate, this Virginia-based firm has approximately 20,000 employees and annual revenues of $2.2 billion. Newport News has been largely dependent on government contracts for nuclear-powered aircraft carriers and submarines. In recent years, however, declining military acquisitions have necessitated a rethinking of the firm's future. In an effort to consolidate the defense industrial base, for example, the U.S. Department of Defense (DoD) eliminated Newport News as a producer of submarines. Future requirements for aircraft carriers are uncertain, but carrier procurements by themselves clearly will not provide sufficient long-term support to the company. As a direct result of these and other defense cuts, Newport News laid off some 4,000 employees (15 percent of the total work force) in 1992-1993.

In this environment, foreign military sales and diversification into commercial markets have come to be seen as the keys to Newport News' future business, and the firm is reorienting to pursue these goals. An extensive analysis of global commercial shipbuilding markets was undertaken, as was a survey of foreign manufacturing capabilities and techniques. In addition, consultants were hired to determine ways in which the shipyard could improve its operating procedures. Newport News managers believe that this program of market and technology research will pay off in coming years by improving the competitiveness of the firm and enhancing its ability to diversify into new markets.

LIQUIFIED NATURAL GAS TANKER MARKET

A cornerstone of the diversification effort has been a drive to enter the liquified natural gas (LNG) tanker market. LNG tankers began operating in the mid-1960s, and approximately 100 ships are currently in service worldwide. LNG tankers are extremely complex vessels, and

relatively few shipbuilders are capable of building them—only 12 yards in five countries have engaged in the construction of these tankers since 1980. They are also a very high-value-added product, typically costing $250 million, or three times the cost of a crude oil carrier of similar tonnage. Japanese companies are very prominent in this market (see Table B-1); however, managers at Newport News believe that their firm's experience in building technologically advanced warships makes it well suited to the construction of LNG tankers as well.

The high cost and complexity of LNG tankers is a result of the advanced containment systems necessary to transport liquified natural gas. The system must control the temperature of the cargo as well as the amount of natural gas that is allowed to "boil off" during transport. This gas is collected and used to power the ship. The four systems currently used in LNG tanker construction are the Technigaz Mark III system, the Gaz Transport system, the Kvaerner-Moss Spherical system, and the SPB system developed by Ishikawajima-Harima Heavy Industries (IHI). The Kvaerner-Moss Spherical system is the most widely used, equipping approximately half the world's LNG tanker fleet. As Newport News prepared to reenter the LNG tanker market, however, it was primarily interested in IHI's SPB system because of operational advantages and because its prismatic shape simplifies design and production, allowing ships to be produced at a lower cost.

The liquified natural gas market itself is concentrated primarily among a few Asian and European countries. Japan is by far the largest importer, followed by France, Spain, Korea, Taiwan, and the United Kingdom. The United States also purchases significant amounts of LNG, but trade is considered less profitable because of domestic availability. The primary advantage of LNG for countries such as Japan is that it is a relatively clean fuel and is often used in power generation. The demand for LNG is closely correlated with the price of oil. In recent years the low price of crude oil has been a major factor in depressed demand for LNG and associated

TABLE B-1 Nations Formerly and Currently Building Liquified Natural Gas Tankers

	Yards Building LNG Tankers[a]	Ships Constructed[b]	Year of Last Delivery
France	5	31	1994
Japan	5	28	1994
Republic of Korea	2	4	1994
United States	2	13	1980
Sweden	1	3	1984
Denmark	1	7	1977
Italy	1	2	1970
Belgium	1	1	1978
Germany	1	1	1977
Spain	1	1	1970
United Kingdom	1	1	1964

[a] Includes yards that have built LNG ships in the past but no longer do so.
[b] Includes ships under construction or ships for which a contract has been awarded.
SOURCE: Newport News Shipbuilding and Drydock Company.

transport systems. The major exporters of LNG are Algeria, Indonesia, Abu Dhabi, Malaysia, and Australia.

Newport News has encountered obstacles in its efforts to become a force in the LNG tanker market. It is common practice for companies that have developed and own the major LNG transport systems to license their systems to other shipbuilders in order to gain income even on projects for which they are not building ships. However, in 1991-1992 IHI refused Newport News' requests to license the SPB containment system. The stated reason was that IHI did not wish to license other shipbuilders until after the first two ships were delivered and the design was proven in service. By 1993, IHI had completed two tankers utilizing its SPB system.

As an alternative to the SPB system, Newport News sought to license the Kvaerner-Moss Spherical system. Newport News intended to use the system in a competitive bid for a contract with the government of Qatar, which was seeking a greater role in the distribution of its liquified natural gas product. The shipyard received assurances from Kvaerner-Moss that the license would in fact be granted if Newport News won the contract, and it submitted a bid to Qatar on that basis. However, the Qatargas Shipping Team insisted that a license was required to be considered in the bidding. When Newport News then tried to secure a license, Kvaerner-Moss refused, saying that the U.S. shipbuilder should be able to prequalify without one. One factor in this situation might have been pressure from a Japanese consortium consisting of Mitsubishi Heavy Industries, Kawasaki Heavy Industries, and Mitsui Engineering and Shipbuilding, which had already licensed the Kvaerner-Moss system for the Qatar project. Qatar refused to consider Newport News' bid as long as it did not have a license from Kvaerner-Moss. With no alternatives, Newport News turned to the U.S. government for assistance. After high-level government contacts, the bid was finally allowed, but the competition was sufficiently advanced that Newport News had little chance of winning the contract.

Newport News was not the only builder to be frozen out by the Japanese consortium in the Qatari LNG tanker competition. Despite its superior technology, IHI was unable to compete successfully against the larger group. A major advantage of the consortium was the large shipbuilding capacity that could be brought to bear, enabling it to deliver a given number of identical ships in a third of the time that an individual shipyard would take. In 1993, therefore, IHI decided to scrap its independent strategy for building global market share in LNG transport systems and informed Newport News of its willingness to license the SPB containment system and form a consortium that would also include Sumitomo Heavy Industries and Fincantieri, an Italian shipbuilder.

IHI recognized several advantages in cooperating with Newport News following its failure in Qatar. Newport News' large manufacturing capacity would increase the consortium's competitive position in bids for future large LNG projects. IHI also perceived Newport News as having significant political influence with the U.S. government. It is likely that events in the Qatari competition, as well as previous instances of government assistance to large U.S. firms, led IHI to believe that a partnership with Newport News might allow it to benefit from such U.S. government involvement in the future.[1] Aside from the strengths of Newport News, IHI found the financing packages that U.S. financial institutions are typically able to put together for projects of

[1]For example, U.S. political leaders publicly supported U.S. commercial aircraft manufacturers in Saudi Arabia's recent purchase. Some have observed that in the wake of the Persian Gulf War such influence by high-level U.S. officials could be expected to be greatest with Middle Eastern nations, which produce much of the world's LNG, and are increasingly influential in transport system decisions because of their interest in vertical integration.

this type very attractive.[2] Finally, a consortium that included a large U.S. partner would be well positioned to compete in the U.S. market should it improve.

Newport News found the arrangement equally appealing. Most importantly, the firm gained access to advanced Japanese LNG containment technology. The terms of the arrangement allow Newport News to use the SPB system on any contract, whether doing so as part of the consortium or as an independent builder. Participation in the consortium, however, will improve the firm's competitive position—particularly in large projects—by allowing it to deliver larger numbers of identical ships more quickly. Finally, the association with IHI has allowed Newport News to assimilate advanced Japanese shipbuilding techniques that hold long-term potential for improving the efficiency of its operations, better enabling it to compete in commercial shipbuilding markets. Newport News reports that IHI has been very open about sharing insights about its manufacturing processes. Implementing some of these techniques will require significant capital investments, but lessons learned from IHI and other global shipyards will help Newport News adopt the most cost-effective and appropriate manufacturing technologies as it works to expand its commercial business in coming years.

FUTURE PROSPECTS

Since Newport News has not yet won a contract utilizing the license from IHI—either by itself or as part of the consortium with IHI and the other yards—it is impossible to assess the bottom-line benefits of the relationship at this point. Certainly, the company's prospects in competition for future LNG projects are considerably enhanced as a result of its unrestricted access to IHI's SPB technology. The case is a promising example of how U.S. defense contractors might leverage international technological capabilities in order to diversify and address commercial markets.

The evolution in IHI's strategy may also be a harbinger of more general shifts in the international strategic alliance approaches of Japanese firms, which have traditionally been eager to enter alliances that enhance their technological capabilities but have been reluctant to share their own technologies. The experience with the Qatar bid showed IHI that a "go it alone" strategy is not feasible in the global market environment for LNG transport systems that is likely to prevail in coming years. The growing need for Japanese companies to reduce manufacturing costs brought about by the long-term appreciation of the yen and fierce global competition—including competition between groups of Japanese companies—might lead to more U.S.-Japan business alliances in which technology flows from Japan to the United States. If such a trend does indeed materialize, it could only help the overall environment for U.S.-Japan relations.

MARINE SYSTEMS TECHNOLOGY PROGRAM

The Newport News-IHI relationship has been further strengthened by their joint involvement in the Marine Systems Technology (MARITECH) program, which was initiated in 1993 to

[2]This might be counterintuitive to some, because Japanese companies have traditionally enjoyed access to relatively inexpensive capital. American financial institutions, however, are very competitive in financing large projects because of their experience in the financial engineering that such projects often entail.

revitalize the U.S. commercial shipbuilding industry. Administered by DoD's Advanced Research Projects Agency (ARPA), MARITECH functions much like the Technology Reinvestment Project. Firms submit proposals for projects to ARPA, and ARPA supplies matching funds to those deemed best able to contribute to the advancement of relevant technologies. Funding for 1994 was $30 million, with another $190 million allocated through 1998.

Presently, the United States is virtually absent from commercial shipbuilding markets. Although the U.S. position had been declining for many years, the erosion accelerated during the 1980s as U.S. military demand rose, U.S. government subsidies for commercial shipbuilding were eliminated while the subsidy programs of other nations expanded, and the worldwide demand for ocean-going commercial vessels fell.[3] With the sharp decline in U.S. Navy procurement of ships in the aftermath of the Cold War, U.S. policymakers realized that U.S. reentry into international commercial shipbuilding markets would be necessary in order to maintain the military shipbuilding industrial base, important both in terms of production capacity required for surge contingencies and sufficient infrastructure for future technology development. The MARITECH program is part of an overall strategy to enhance U.S. competitiveness in commercial shipbuilding. The strategy also incorporates financing and marketing assistance, as well as a focus on leveling the international competitive playing field through trade policy.

MARITECH seeks to improve the competitiveness of U.S. shipbuilders by fostering the creation of technologies that will help American shipyards produce commercial vessels more quickly and profitably. The emphasis is on helping firms advance beyond their current methods of operation, shaped by years of dependence on government contracts, and develop more proactive, market-oriented approaches to ship design, product development, construction, and international marketing. In an effort to ensure the near-term survival of U.S. shipbuilding firms, early MARITECH funding will be heavily invested in production-oriented, market-driven projects that can be implemented in two to three years.

An international partnership led by Newport News received $3 million in MARITECH funding in fiscal year 1994. Designed to facilitate the company's conversion to a world-class commercial shipbuilder, the project entails the design of a 40,000-dead-weight-ton tanker using comprehensive market analysis, advanced production processes, and revised project management. IHI is one of eight partners in the project.

Foreign participation is common among groups receiving MARITECH funding; 16 of the 20 projects receiving MARITECH awards in 1994 included at least one foreign firm. ARPA encourages foreign participation as many of the advanced technologies and production techniques needed to improve the efficiency of U.S. shipbuilders are found in foreign yards. Given the strong position of the Japanese commercial shipbuilding industry, Japanese companies are prominent among the foreign participants—nine of the 20 MARITECH projects funded for 1994 include Japanese firms, with IHI participating in four and Kawasaki Heavy Industries participating in three (see Table B-2).

MARITECH represents a significant experiment in U.S. technology policy. The program fits with the overall recent movement toward expanded U.S. government support for commercial technology development through a variety of government-industry partnerships. ARPA's Technology Reinvestment Project and the Advanced Technology Program of the U.S.

[3]See papers prepared by Charles E. Stuart, Robert Schaffran, and Donald Fraser, "MARITECH: Shipbuilding Technology for Commercial Competitiveness," November 1993.

TABLE B-2 Marine Systems Technology (MARITECH) Program Awards with Japanese Participation, Fiscal Year 1994

Project	Number of Partners	Primary Awardee	Japanese Partners	Federal Funding, $ million
23,000-ton container/ bulk carrier	2	Halter Marine	Ishikawajima–Harima Heavy Industries (IHI)	1.0
Multipurpose cargo ship design/ process development	5	McDermott	IHI	3.9
U.S.-built cruise ships—designs for the world market	6	National Steel and Shipbuilding	Kawasaki Heavy Industries (KHI)	0.4
Integration of modern manufacturing methods	2	Todd Pacific Shipyards	Maritech Engineering Japan Co.	1.6
Focused technology development	10	Avondale Industries	Mitsubishi Heavy Industries	2.3
Petroleum product tanker development	13	Gibbs & Cox	IHI	0.8
Market and producibility–driven tanker design	9	National Steel and Shipbuilding	KHI	0.2
Conversion to a world–class commercial shipbuilder	8	Newport News Shipbuilding	IHI	3.0
Internationally competitive ships for the 1990s	3	National Steel and Shipbuilding	KHI; Kawasaki Kisen (K-Line)	0.2

SOURCE: U.S. Department of Defense, Advanced Research Projects Agency.

Department of Commerce are the most prominent examples of this approach. MARITECH is unique among these in that it targets an industry—commercial shipbuilding—from which the United States has been almost completely absent for a number of years. This contrasts with the SEMATECH semiconductor manufacturing consortium that ARPA launched with a number of U.S. semiconductor companies in the late 1980s. The U.S. semiconductor industry, while facing significant challenges, particularly from Japan, still held a large share of the world market when SEMATECH was launched. Since MARITECH is part of a strategy to facilitate U.S. reentry into an industry with entrenched technologically advanced international competitors, success will require that U.S. companies access and effectively utilize technological capabilities from around the world, including Japan. MARITECH may represent the only U.S. government technology

policy initiative that implicitly encourages foreign participation of this type—an open approach required by the circumstances.

Just as success is not assured for Newport News-IHI alliance in LNG tankers, there is no guarantee that the MARITECH program as a whole or the individual projects involving Japanese companies will succeed in revitalizing U.S. commercial shipbuilding capabilities. A favorable market environment for the remainder of this decade may represent a critical window of opportunity, since the demand for various types of commercial ships is projected to rise significantly. Japan's high production costs and growing competition with Korean and other shipbuilders may lead to expanded opportunities for U.S.-Japan alliances that produce long-term, mutual benefits.

In light of the DoD's recent efforts to pursue a more reciprocal U.S.-Japan exchange of technologies through the Technology-for-Technology initiative, and U.S. government technology policies more broadly, the MARITECH experiment should perhaps be studied closely as the results become more clear over the next several years. As an existing program in which the DoD is facilitating transfer of Japanese and other foreign technologies to build the dual-use capabilities of U.S. companies, it could serve as a model for future initiatives to the extent that it succeeds.

Appendix C

U.S. National Security and the Risks of Dependence on Foreign Technologies and High-Technology Products

BACKGROUND

There have been numerous incidents in recent decades that illustrate the potential dangers of foreign technology and component dependence. Governments of technologically advanced nations, including the United States, frequently use technology as a lever with which to influence the policies and actions of other nations. The issue of dependence should be examined in the context of limiting American vulnerability to such manipulation.

Theodore Moran cites several pertinent examples.[1] In the 1960s the United States ordered IBM to withhold computer technology from France in order to inhibit that nation from developing an independent nuclear deterrent. Although the United States was ultimately unsuccessful in preventing France from acquiring nuclear weapons, the fundamental implications for French national security of such actions are clear. Twenty years later the Reagan administration ordered U.S. firms to cancel contracts to supply technology for the Soviet natural gas pipeline in Europe. The U.S. action became an extremely contentious issue and was denounced by NATO allies taking part in the project.

For national security purposes, "(1) a foreign source is a source of supply, manufacture or technology outside the United States and Canada; (2) a foreign dependency refers to source of supply for which there is no immediate available alternative in the United States or Canada; and (3) foreign vulnerability, related to foreign dependency, refers to a source of supply whose lack of availability jeopardizes national security by precluding the production, or significantly reducing the capability, of a critical weapons system."[2]

Reliance on foreign suppliers for critical military components and technologies and the related risks have attracted attention and concern in the United States over the past decade.[3] As a result of the erosion of indigenous production capability in some key areas and growing technological-industrial capabilities in other countries, U.S. defense industries now utilize

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[1]Theodore H. Moran, *American Economic Policy and National Security* (New York: Council on Foreign Relations, 1993), pp. 44-45.

[2]Martin Libicki, Jack Nunn, and Bill Taylor, *U.S. Industrial Base Dependence/Vulnerability: Phase II—Analysis* (Washington, D.C.: National Defense University, 1987), as summarized in U.S. Congress, General Accounting Office, *Risks of Foreign Dependencies for Military Unique Critical Technologies* (Washington, D.C.: U.S. Government Printing Office, 1992), p. 1.

[3]A number of studies and articles on this issue have been conducted in recent years, such as Institute for Defense Analysis, *Dependence of U.S. Systems on Foreign Technologies*, 1990; The Analytical Science Corporation (TASC), *Foreign Vulnerability of Critical Industries*, 1990; National Defense University, *U.S. Industrial Base Dependence/Vulnerability*, 1987; and Theodore Moran, "The Globalization of America's Defense Industries: Managing the Threat of Foreign Dependence," *International Security*, Summer 1990. These reports are summarized in U.S. Congress, General Accounting Office, *Assessing the Risk of DOD's Foreign Dependence* (Washington, D.C.: U.S. Government Printing Office, 1994).

foreign sources for a wide variety of components and production equipment. Japan has been a focus for rising concerns in this area because of its strong technological-industrial capabilities. In particular, Japanese companies dominate several of the most well-known areas of U.S. dependence in dual-use components and equipment. The two most significant U.S. policy initiatives relevant to this discussion have addressed areas of U.S. weakness vis-à-vis Japan, with implications for dependence on Japan or Japanese denial of critical technologies—significant Department of Defense (DoD) financial support for the SEMATECH research and development (R&D) consortium and the National Flat Panel Display Initiative announced in 1994.

Japanese and other foreign producers may be able to supply components of better quality or lower cost or may be the only available source of a specific technology. However, foreign sourcing and dependence carry potential national security liabilities. For the purpose of conceptualizing the issues, it is useful to distinguish between the short-run, acute risks of inadequate supplies of components or equipment for surge or mobilization contingencies, as well as the longer-term risks of inadequate access to foreign technologies during the development phase for new systems, and spillover effects that the absence of domestic capabilities might have on upstream and downstream industries. As explained below, dependence in some component and equipment areas carries both short- and long-term risks.

SHORT-TERM RISKS

In short-term contingencies the key national security imperative for any critical component or piece of equipment is to obtain adequate supplies for peacetime surges in production or general mobilization. The criteria used to evaluate the risk of foreign dependence in manufactured products are similar to those that would apply to strategic commodities or materials. Concretely, concerns about foreign sources revolve around several possible scenarios that would block adequate supply. For example, foreign production sites or transportation channels might be destroyed or disabled by military action, natural disasters, or accidents. Foreign sources might also withhold supply from the United States for political reasons; the government of a foreign production site might be allied with countries hostile to the United States, be threatened by such countries, or may be under the pressure of public opinion to withhold the component or piece of equipment in question. Even if supplies are not withheld, foreign sources could not be compelled and might be reluctant to divert production from other customers to meet increased U.S. military demand during a crisis.

Table C-1 shows the most important criteria for evaluating these short-term risks. As is apparent, the risks of dependence increase with the criticality of the component, surge and mobilization production requirements, the concentration of suppliers, and the political relationship of supplier governments with the United States.

The overall extent of foreign dependence and foreign sourcing is generally unknown, particularly at the lower tiers of the supplier base.[4] The preponderance of publicly available information indicates that foreign dependence, particularly dependence on Japanese sources at the

[4]U.S. Congress, General Accounting Office, *Significance of DOD's Foreign Dependence* (Washington, D.C.: U.S. Government Printing Office, 1991), p. 1.

TABLE C-1 Factors in Evaluating Short-Term, Production-Related Component/Equipment Dependence Risks

	Low Risk	High Risk
Criticality of system mission	Noncritical	Critical
Mobilization/surge production requirement	Low	High
Number of suppliers	Numerous	Few/one
Proximity of suppliers to each other	Dispersed	Few/single country
Proximity of suppliers to the United States	Nearby	Distant
U.S. political relationship with supplier government	Stable ally	Unstable

SOURCE: Office of Japan Affairs staff.

lower tiers, is extensive.[5] Manufacture of a number of critical electronics materials, components, and equipment became concentrated in Japan during the 1980s as Japanese industry's competitiveness in the semiconductor and related industries rapidly advanced. Therefore, it is safe to assume that dependence on Japanese sources in U.S. military production increased as well over that period.[6]

A good example for evaluating these concerns in the context of Japan is ceramic semiconductor packages.[7] Ceramic packages are key components for microelectronics installed in virtually every military system. Not only are they critical, but because they are used in the guidance systems of missiles and other "consumable" systems, increased production for surge or mobilization might represent a significant increment. Although there are several domestic suppliers, imports account for about 90 percent of identifiable defense shipments.[8] A single Japanese company, Kyocera, holds over half the world market, and most other significant players are Japanese, so foreign sources are few and concentrated. Kyocera is the largest domestic merchant supplier but imports critical materials to its U.S. facility.[9] Japan is distant, so transporting larger shipments during a crisis might be difficult. Although the U.S.-Japan security

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[5]For example, U.S. Department of Commerce, Office of Industrial Resource Administration, *National Security Assessment of the Domestic and Foreign Subcontractor Base: A Study of Three U.S. Navy Weapon Systems* (Washington, D.C.: U.S. Department of Commerce, 1992).

[6]In several cases, such as high-quality polysilicon, remaining U.S. manufacturers were acquired by Japanese competitors. See Thomas R. Howell, Brent L. Bartlett, and Warren Davis, *Creating Advantage: Semiconductors and Government Industrial Policy in the 1990s*, Semiconductor Industry Association and Dewey Ballantine, 1992.

[7]U.S. Department of Commerce, Office of Industrial Resource Administration, *The Effect of Imports of Ceramic Semiconductor Packages on the National Security: An Investigation Conducted Under Section 232 of the Trade Expansion Act of 1962* (Springfield, Va.: National Technical Information Service, 1993).

[8]Ibid., p. ES-5.

[9]Ibid., p. VII-2.

alliance might indicate that politics would not be a factor, "Kyocera has at times been reluctant to acknowledge the extent to which its packages are exported for military applications," owing to the unfavorable image of defense suppliers among many Japanese.[10]

The factors listed in Table C-1 are predominantly in the high-risk category in the ceramic package case. DoD has stated "that it is important to maintain a national security capability to produce semiconductor packaging, particularly custom packages and those used in space applications and heavily corrosive environments."[11] U.S. merchant production of ceramic packages has declined in recent years, as several domestic producers have scaled back production or exited the business, and remaining producers have cut back investment and R&D. In early 1993 two of the remaining domestic producers petitioned the Department of Commerce to conduct an investigation under Section 232 of the Trade Expansion Act of 1962, which allows for trade relief to domestic companies if imports are found to threaten national security. Although the U.S. government ruled following the investigation that imported ceramic packages do not represent a threat to national security, the weakness of the domestic production base was recognized, and an action program focusing on technology development and manufacturing was instituted in 1993. The Department of Commerce has committed to monitoring the situation in the event that further actions are needed to maintain domestic production.

Even in the ceramic package case, where there is a clear national security imperative to maintain a domestic production and technology base, policy alternatives for managing or reducing this dependence involve difficult trade-offs. Some form of trade relief—such as tariffs on imported packages—would have been the most direct solution. This would encourage investment in production capability and R&D by both U.S. and foreign-controlled producers. But tariffs would raise costs for DoD contractors, and ultimately DoD itself, as well as for U.S. commercial users.[12] The imposition of tariffs would therefore be politically difficult, especially in the current context in which the risk of attack and supply disruption has declined in the aftermath of the Cold War. Stockpiling, an alternative used in some cases to manage dependence on critical minerals or other materials, would also be expensive and more complex to administer than tariffs.[13]

The U.S. action plan represents a reasonable interim course, providing assistance while monitoring the status of the domestic industry. However, even if the domestic industry can achieve a significant and stable market presence, remaining uncertainties make dependence on Japan in this and other areas problematic. First, DoD's knowledge of dependencies, particularly at lower supplier tiers, does not appear to be adequate for an environment in which the reliance of military systems on commercial technologies will rise. In many of these areas, Japan and perhaps other foreign countries are increasingly strong. During the Section 232 investigation, DoD was not able to identify exact quantitative requirements for ceramic packages during a national security emergency, owing to the rapidly changing security environment.[14] While tracking down, evaluating, and managing every foreign dependency would be cumbersome and expensive, it is

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[10]Ibid., p. VI-26.

[11]Ibid., p. VII-2.

[12]Semiconductor makers increasingly use ceramic rather than plastic packaging for the highest-value-added commercial chips.

[13]Although, on the assumption that a foreign policy crisis significantly impacting U.S. military demand would take some time to develop, emergency stockpiles could presumably be built up at that time.

[14]Ibid., p. ES-7.

important that an ongoing effort be made to keep track of at least the most obvious and important cases, such as ceramic packages, even before domestic producers petition for import protection.[15]

A second problem revolves around the ambiguous attitude of Japanese companies and the Japanese government toward this issue. Although DoD reportedly has received assurances from Japan that the supply of ceramic packages would not be cut off and that the product is not subject to the three export control principles, one can certainly conceive of circumstances under which increased Japanese supply of packages for U.S. military demand would become politically difficult for Japanese companies. Regardless of whether it is made clear to the Japanese public, it is likely that reluctance on the part of Japanese companies to supply commercial technologies for U.S. military use will affect U.S. perceptions of Japan's reliability as an ally and U.S. willingness to transfer military technology to Japan. Some might argue that DoD and other government officials should take Japanese and other foreign supplier attitudes into account in determining the appropriate scale of domestic production, the acceptable level of dependence by foreign-controlled domestic producers on critical inputs from abroad (such as "green tape" or the unfired ceramic material that is the basic input in the case of ceramic packages), and the trade policy and other instruments necessary to ensure adequate supply.

LONG-TERM RISKS

Dependence carries two types of long-term risks. The first is that lack of U.S. capabilities in a given critical technology might delay or inhibit incorporation of that technology into new systems. For a number of reasons, foreign sources may be unwilling or unable to supply the United States with the technologies needed for modernization. Failure to maintain U.S. leadership in key areas therefore threatens to erode the technological superiority that is the basis of U.S. military planning. As the timeframe expands, the difficulty in predicting the risk of dependence increases as certain factors, such as the evolving nature of warfare and the important technologies of the future, become clouded.

A second type of long-term risk of dependence involves spillover effects for a broad industry or a key input. Dependence in one area could have impacts in related areas, leading to a more general downgrading of U.S. technical and manufacturing capabilities. These "industrial food chain" effects can work in both directions. Moving down the food chain, for example, when Japanese companies gained leadership in most areas of consumer electronics in the 1970s, it enhanced the ability of these companies to increase their international competitiveness in semiconductors and microelectronics. Moving back up the food chain, Japanese strength in advanced microelectronics contributed to competitive inroads in segments of the computer industry during the 1980s, particularly IBM-compatible mainframes and supercomputers.

Table C-2 lists the risk factors for both inhibited or denied technology incorporation, as well as industrial erosion risks. Although technology access relates to specific military needs and industrial erosion is a more diffuse problem, the two risks are interrelated. To return to the above example of the consequences of eroding U.S. capabilities in consumer electronics, Japanese companies such as Sharp nurtured and developed their capabilities in liquid crystal display technologies in the consumer electronics market during the 1970s and early 1980s. DoD's Flat

[15]Much of the analysis in the literature on this subject focuses on frameworks for determining which dependencies represent potential vulnerabilities because of foreign supplier concentration.

Panel Display Initiative has been deemed necessary partly because of concerns about adequate access to this technology for future military systems.

Technology Access

Indeed, the situation with flat panel displays is a good example of the former, military-system-specific, risk. DoD has stated that reliance on commercial technologies must increase in order to lower acquisition costs and because in such areas as electronics commercial technology is outstripping advances on the military side. Today, several small specialized U.S. vendors supply DoD's requirements. Although these domestic suppliers are technologically sophisticated, U.S. flat panel display producers are not present in the high-volume markets, such as laptop computers, that are driving manufacturing technology and costs.[16] These markets are dominated by Japanese companies. Even in a technology that is driven by commercial developments, at least some military applications are likely to require enhancements or modifications. In the area

TABLE C-2 Factors in Evaluating Long-Term Technology and Manufacturing Base Component/Equipment Dependence Risks

	Low Risk	High Risk
Criticality of technology	Low	High
Motivation of suppliers	Competes with U.S. user	Does not compete
Entry barriers	Low	High
Acceptable substitutes	Yes	No
Reliable legal sanctions for anticompetitive behavior	Yes	No
Number of suppliers	Numerous	Few/one
Proximity of suppliers to each other	Dispersed	Few/single country
Supplier dependence on U.S. customers	Meaningful interdependence	Supplier not dependent
Market	Commodity	Growing rapidly
Technological/business spillovers	Significant	Not significant

SOURCE: Office of Japan Affairs staff.

[16]Display Technologies Inc. (DTI), a joint venture between IBM and Toshiba, manufactures displays for commercial markets in Japan.

of displays, these might include special sizes or operational tolerances. It may, therefore, not be feasible to buy unmodified commercial displays from foreign vendors. DoD officials have stated that it will be necessary to have advance access to prototypes, assured access to customized products utilizing the latest commercial technology, and the benefit of lowered cost that comes from volume production.

DoD's display initiative has several elements, including core technology funding (which has been ongoing for a number of years), R&D support for companies that commit to build production facilities, aggregation of government procurement demand, and interagency monitoring. The total cost over five years is expected to be $587 million.

Some experts have criticized DoD's approach, saying that the initiative represents a misguided foray into industrial policy that will backfire over the long term.[17] These criticisms include the following:

- that the initiative is expensive and has not been adequately weighed against DoD's other technological priorities;

- that the initiative is driven by competitiveness rather than security concerns;

- that the initiative is risky, since it is still unclear which display technologies will ultimately best meet DoD's needs;

- that juxtaposing military and civilian production in the same facilities will make it difficult to meet DoD's production goals;

- that as Korean and perhaps other companies enter the market, flat panel displays are likely to become commodities, leading to intense price competition—U.S. entrants would be hard pressed to become profitable competing in commercial markets;

- that the initiative will cause trade friction—subsidizing R&D for companies that commit to production skirts GATT provisions, and recipients of DoD support will eventually press for trade protection; and

- that DoD can meet its needs by pressing more forcefully on the Japanese government for access or by cooperating with Korean companies—furthermore, Japanese and Korean companies are likely to invest in U.S. production capability at some point in the near future.

Some of these criticisms are more compelling than others. To begin with the less compelling, a large part of the funding represents core technology support. Display technology has been a priority area for DoD R&D support for a number of years, so this aspect of the initiative does not represent a significant expensive shift in priorities. The main increment—the $199 million over five years slated for R&D subsidies to encourage production—works out to $40 million annually. If, as is likely, DoD spends as much or more on other technology programs that are not rigorously prioritized, this objection would apply to other programs as well.

[17]These objections are drawn mainly from Claude Barfield, "Flat Panel Displays: A Second Look," *Issues in Science and Technology*, Winter 1994-95, pp. 21-25.

Regarding the appropriateness of U.S. government motivations for launching the initiative, it can certainly be argued that competitiveness concerns had much to do with driving the policy. Still, clearly, high-information displays are a critical technology for future military systems.[18] As for the criticism that DoD support risks distorting technology development, DoD continues to support a variety of technologies and approaches, so the technological risks should be no greater than they are in any technology support program; DoD funding might lead to significant breakthroughs, but the $40 million per year that focuses on production is probably not large enough to influence anybody's technological calculations, particularly since these grants would involve significant cost sharing. Further, although juxtaposing military and civilian production may impede quick realization of production and market share goals, U.S. production that meets DoD's needs at reasonable costs will need to be established at some point. Finally, regarding the argument that the initiative will cause trade frictions, it is important to note that trade friction in this area existed prior to the DoD initiative. Several small U.S. producers filed and won an antidumping complaint against Japanese manufacturers several years ago, prompting U.S. computer manufacturers to move production of laptop computers out of the United States.[19] As long as some U.S. companies remain active in displays, there is a possibility for trade friction. To the extent that U.S. producers are able to compete in commercial markets, there would presumably be less pressure for protection.

The three more compelling criticisms revolve around future market entry, the ultimate feasibility of establishing a profitable U.S. production base, and the utility of alternative strategies such as pressing harder on the Japanese government or working with Korean companies. They are somewhat related and revolve around the basic question of whether U.S.-controlled mass production of displays in the United States is a critical enough security need to justify a significant government initiative and whether success is achievable at a reasonable cost.

The short answer is that there is insufficient information at this point to answer these questions definitively. However, it is possible to make several salient points in the context of our discussion of dependence. Japanese companies have reportedly indicated that they would not be willing to work with DoD, but even if one or more of the Japanese companies that currently dominate the market were willing to do so, future dependence on Japan for military displays would be problematic, since the risk factors identified in Table C-2 are predominantly on the high end of the scale. For example, current production is concentrated in Japan, particularly for the active matrix liquid crystal displays whose demand is growing fastest. Entry barriers are high—Japanese companies are planning to spend about $2.5 billion on production capacity over the 1994-1996 timeframe[20] (see Table C-3). Except for a few key U.S. strengths, such as glass

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[18] Kenneth S. Flamm, "Flat-Panel Displays: Catalyzing a U.S. Industry," *Issues in Science and Technology*, Fall 1994, pp. 27-32, explains the rationale for the program. Barfield, op. cit., raises a variety of objections. Although Barfield argues that DoD's estimates of near-term military demand are overstated, and therefore there should be no urgency to launch a major government initiative, he does not contest the fundamental importance of the technology for future defense needs.

[19] "In requesting the lifting of the 62.67 percent import duty on active matrix flat panel displays, OIS Optical Imaging System, Inc. and owner Guardian Industries—the only U.S. producer of this type of display—argues that the order has already served our purpose, and there's really no reason to burden American computer manufacturers." See Eduardo Lachica, "Display Antidumping Saga Awaits Clinton Resolution," *The Asian Wall Street Journal*, January 25, 1993, p. 4.

[20] "TFT-shiki ryosan ni hakusha," *Nihon Keizai Shimbun*, June 23, 1994, p. 13.

TABLE C-3 Major Japanese Thin-Film Transistor LCD Makers' Actual and Planned Capital Investments

Company	Plant	Capital Spending (million dollars)	Date Operational
Sharp	Mie	530	July 1995
DTI[a]	Yasu	300-400 (est.)	1995
NEC	Akita	300	October 1994
Hitachi	Mobara	300	1994
Fujitsu	Yonago	390	March 1994
Hoshiden	Kobe	300-400	By 1997
Matsushita	Ishikawa	200-300	End of 1995
Mitsubishi Electric and Asahi Glass	Advanced Display	130	Summer 1995

[a] DTI is a joint venture between IBM and Toshiba.
NOTE: Currency conversion at ¥100 per dollar.
SOURCE: *Nihon Keizai Shimbun*, June 23, 1994, p. 13.

and some of the related microelectronics, U.S. manufacturing infrastructure for displays is weak overall.[21]

Significant Korean entry and success would alleviate several of the dependence risk factors. The market would be less concentrated. South Korean companies might be more willing to work with DoD, which in turn would likely lead to greater Japanese willingness. Korean firms were able to enter the market for dynamic random-access memory (DRAM) chips, which has significantly alleviated concerns about access to DRAMs by U.S. commercial users. Although Korean companies may ultimately be successful, this is not assured. Active matrix liquid crystal displays share some characteristics with DRAMs, such as the need for large capital investments and the imperative for meticulous efforts to improve manufacturing yields. However, manufacturing technologies are advancing rapidly, and Japanese companies have a significant lead.

Several types of workable arrangements for international collaboration to meet DoD needs in flat panel displays are conceivable. DoD or U.S. contractors could work exclusively with South Korean or Japanese suppliers on customized displays for DoD, manufactured in those countries. This arrangement would have the drawback of leaving the United States completely dependent on foreign production and technology. At the very least, displays appear to be critical enough that maintaining U.S. technological capabilities and small-scale production—even without U.S.-

[21]"It was clear that there exist within Japan the elements of the complete business cycle—display panel material; display production machinery; factories for LCD, EL, plasma and so forth; and an end-use market. Additionally, almost all the peripheral electronic and display-based product electronics are made in Japan. The only exceptions of note are that approximately 70 percent of the basic LC materials are manufactured in Europe, and approximately 90 percent of the a-Si TFT glass substrates and EL glass substrates are manufactured in the United States by Corning. Corning has announced that it will build a glass factory in Japan." See Lawrence E. Tannas, Jr., William E. Glenn, Thomas Credelle, J. William Doane, Arthur H. Firester, and Malcolm Thompson, *JTEC Panel Report on Display Technologies in Japan* (Baltimore, Md.: JTEC, 1992), p. 17.

based mass production—is well justified on national security grounds. This state of affairs is similar to the current situation. DoD research funding has maintained fairly strong U.S. R&D capabilities in displays in the absence of a large production base. But if production of displays for DoD were to be entirely contracted out to foreign producers, support for small-scale U.S. production would lose an important rationale, making it more difficult to justify domestic R&D support. Why not just support the R&D activities of Japanese and Korean producers?

If complete dependence on foreign display technology is unacceptable from a national security standpoint, mass production in the United States would enhance national security in the long term by lowering the production-related risks outlined above and by providing a larger revenue stream for U.S.-based R&D activities. Such U.S. production facilities could be foreign owned, U.S. owned, or mixed. DoD's current approach is to support U.S.-owned efforts, although officials have stated that they are willing to support foreign-owned firms that establish U.S. production facilities. This could be attractive, particularly if U.S. companies are involved as partners in joint-venture activities.

It can be argued that, as currently constituted, the Flat Panel Display Initiative is a reasonable approach to a serious national security problem under conditions of high uncertainty. It seeks to continue and strengthen support for U.S. technological capabilities in the critical area of displays, while on the margins encourage an expanded domestic production base. Rather than an expensive and risky course, the more likely danger is that an effort of this scale is insufficient to ensure a U.S. mass production presence in commercial markets. It may well be the case that the required investment levels are too great and profit potential too long term for U.S. companies to commit without government intervention—through trade policy or subsidies—on a much larger scale. At some point in the next several years, the United States may face the choice of becoming dependent on foreign sources and technology—as Japanese and Korean producers race ahead of U.S. efforts funded primarily by DoD—or making a significantly larger investment. For now the current approach maintains a technological and business option to develop an industry, and it may succeed in stimulating the desired critical mass of manufacturing capability. It may also increase DoD's leverage with foreign producers, perhaps stimulating investment in U.S. manufacturing. In addition to continuing in this effort, DoD might actively study and perhaps explore in discussions modalities for tapping foreign capabilities, such as encouraging U.S. joint-venture facilities. A highly visible collaborative effort with Korea, should it be successful, might also stimulate a more forthcoming attitude on the part of Japanese companies.

INDUSTRIAL BASE EROSION

Dependence on foreign sources raises a more diffuse risk to national security—that capabilities lost in one segment will weaken related sectors, leading eventually to a general downgrading of U.S. technological capabilities in a broad industrial area, or that broad industry weakness will adversely affect specific supplier segments that are critical to national security. According to one formulation, manufacturing and technological capability in high-value-added industries has an intrinsic worth to a dynamic economy that is greater than the value of output at a given point in time. A critical mass of capability built through interaction between suppliers and end users facilitates the development of an institutional and human resource base, which leads to inter- and intraindustry spillovers (sometimes regionally bound) and higher growth rates

for the industry and the entire economy. Some argue that Japanese technology and industrial policies recognize this dynamic better than those of the United States, leading Japan to emphasize indigenization and nurturing of technological capability.[22]

The trends of the 1970s and 1980s certainly bear out this assertion. For example, loss of U.S. commercial competitiveness in an industry that at first glance appeared to have little security importance, consumer electronics, has indeed contributed to the current lack of a U.S. presence in mass production of flat panel displays. The strength of Japanese companies in DRAMs was leveraged to gain advantages in key areas of semiconductor equipment, such as photolithography. There is some evidence that during the late 1980s individual Japanese companies and production networks utilized practices that are illegal and considered anticompetitive in the U.S. context to pursue their advantage.[23] Concerns were raised about Japanese direct investments in U.S. high-technology companies—in some cases the last remaining companies in their segments. It appeared to some that broad dominance in information-related industries was within the reach of the large Japanese electronics companies.

The situation looks somewhat different in 1995. Today, it is clear that closed production networks and markets, and the focus on acquisition and improvement of technology at the expense of the creation of new technology have imposed costs on Japan. For example, if the Japanese computer market had been more open in the 1980s, Japanese companies might have recognized the importance of networked personal computers earlier and adjusted their strategies accordingly. Japan's dominance in DRAMs and huge profits attracted new market competition from Korean firms. As U.S. semiconductor and computer companies focused on higher-value-added products and new technologies, many have been able to grow and even establish strong positions in the Japanese market.

However, Japanese companies remain dominant in many areas of the semiconductor and semiconductor equipment industry. If the emerging global competition in high technology is marked by a constant struggle with various companies and national industries enjoying periods of relative ascendancy and decline, another period of Japanese ascendancy is likely or possible.[24] What are the lessons that can be drawn from recent years?

One possible conclusion is that technology policy measures have contributed to maintaining U.S. capabilities at the margins, but that market forces and the competitive adjustments made by U.S. companies themselves are much more important as contributing factors. For example, because of concerns about the eroding U.S. position in the semiconductor industry, the Semiconductor Manufacturing Technology Consortium (SEMATECH) was formed in 1987. With 14 corporate members, SEMATECH initially received $100 million annually in matching funds from the Advanced Research Projects Agency, primarily to conduct research on advanced

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[22]Richard J. Samuels, *Rich Nation, Strong Army: National Security and the Technological Transformation of Japan* (Ithaca, N.Y.: Cornell University Press, 1994).

[23]"Officials from several government agencies told us that Japanese companies were engaged in tying practices between 1987 and 1989. One agency official stated that his office brought up the issue of tying 9 to 10 times during consultations with the Japanese government and asked the government to encourage Japanese companies to discontinue these practices. This official confirmed that U.S. companies licensed technology to Japanese companies in order to get memory chips." See U.S. Congress, General Accounting Office, *International Trade—U.S. Business Access to Certain Foreign State-of-the-Art Technology* (Washington, D.C.: U.S. Government Printing Office, 1991), pp. 43-44.

[24]George Gilboy, "Technology Dependence and Manufacturing Mastery," briefing paper for the Defense Task Force, February 1995.

manufacturing techniques and semiconductor materials. SEMATECH is given some credit for the resurgence of U.S. semiconductor manufacturers. The program has been so successful that its managers announced in 1994 that they would not seek continued government funding after 1997. The SEMATECH experience has demonstrated that government and industry can work together to preserve critical U.S. industries and prevent foreign technological dependence.

However, despite the successful efforts of SEMATECH to work with GCA Corp. to develop an advanced stepper that many experts considered the best in the world, U.S. semiconductor companies, including SEMATECH members, were not willing to commit to purchasing the machines. As a result, GCA Corp. was forced to shut down in 1993. This case illustrates that even when technology policies are effective other policy measures might be necessary to maintain U.S. capabilities.

Although the rapid erosion of U.S. capabilities in electronics appears to have halted and may even have been reversed in some areas, the United States remains dependent on Japan for a large range of electronics-related technologies and products. What should the priorities of U.S. policymakers be for the future, particularly during a future period of competitive ascendancy for Japan?

Considering the ongoing globalization of technology, declining U.S. defense budgets, and the increasing interdependence of the world's economy, it is unreasonable to expect the United States to maintain self-sufficiency in all critical technological areas. The costs of attempting to do so would be staggering. Also, there are advantages to a certain level of interdependence—the United States is able to incorporate advanced foreign technologies into new weapons systems, it may be able to procure components at a lower cost, and it can focus resources on potentially more important priorities. It must therefore be accepted that some degree of foreign dependence will exist.

To cope with short-term, production-related risks (illustrated by ceramic packages) and longer-term technology access risks (illustrated by flat panel displays), the key in limiting vulnerability to foreign dependence lies in an assessment of the risk presented by each individual case. Criticality and the potential for loss of access are the primary determinants of that risk. When a significant risk is determined to exist, the U.S. government possesses several policy options to address it, such as stockpiling and ensuring adequate domestic production of critical components and technologies. The Defense Production Act, for example, authorizes the use of financial incentives to expand domestic production for items with limited commercial demand. The Trade Expansion Act allows U.S. firms to petition the government to restrict foreign imports in cases where the loss of domestic production is thought to entail national security risks. The Committee on Foreign Investment in the United States also exists to prevent the loss of such critical capabilities. It appears that the U.S. government has pursued reasonably effective policies related to these straightforward national security risks in recent years, although determining the appropriate course has often been marked by contention.

The risk of industrial erosion, although apparently quiescent for the time being, remains a long-term concern. As long as the U.S. economy, technology infrastructure, and production networks remain significantly more open than Japan's, a potential risk is present. U.S. concerns would be reduced if faced with evidence of greater openness in Japan. In this sense, access to the Japanese market in high-technology products is a significant barometer.

The longer-term security risk also represents a short- and long-term competitiveness risk. In the past, DoD has funded R&D initiatives and other measures to build and maintain U.S.

capabilities in specific areas of commercial technology with significant military applications and national security importance, cooperating with other agencies as necessary. Even though efforts to monitor and address these issues are on the rise, managing dependence is an issue that will be with us for the foreseeable future. Japan is likely to continue to be at the center of the dependence issue.

Appendix D

Possibilities for U.S.-Japan Cooperation in Theater Missile Defense

BACKGROUND

One possible area for U.S.-Japan cooperation in defense technology is theater missile defense (TMD). The object of TMD is to provide protection for targets or regions subject to short- to mid-range ballistic missile attacks.

During the Cold War, Japan enjoyed the protection of the U.S. nuclear umbrella as a safeguard against ballistic missile attack from the Soviet Union. Now that the Cold War has ended, there is some concern that the threat of U.S. nuclear retaliation may not provide adequate protection against ballistic missile attacks (not necessarily nuclear) directed at Japan from elsewhere in the Northeast Asian region.

The United States has made significant progress in TMD technology. Japan, due to its relatively small geographic area, is well suited to TMD; indeed, for Japan a TMD system would approximate national missile defense. Thus, both the growing technical feasibility of effective TMD systems and the current and future ballistic missile capabilities of countries in the Northeast Asian region suggest an opportunity for U.S.-Japan defense technology cooperation in this area. Currently, U.S.-Japan discussions are moving forward in the context of a joint study of Japan's TMD requirements under the leadership of the Japan Defense Agency (JDA).

U.S. CAPABILITIES AND PLANS

Current U.S. TMD capabilities are limited to terminal defense against short- to medium-range (70- to 2500-km) ballistic missiles provided by the Army's Patriot PAC-2 missile system. The Patriot missile system and PAC-2 missile have been improved to enhance antitheater ballistic missile (ATBM) capabilities since the Persian Gulf War.[1]

During the 1980s, the U.S. Department of Defense (DoD) enjoyed a high level of funding support for missile defense research as part of the Reagan administration's Strategic Defense Initiative (SDI). The goal of SDI was a national defense against intercontinental ballistic missiles. With the end of the Cold War resulting in a lower threat of a full-scale strategic missile attack as well as the increased focus on theater missile threats that emerged following the Persian Gulf War, the Clinton administration scaled back this effort and refocused missile defense research on ground-based defense against tactical ballistic missiles.

Three programs form the core of U.S. near-term plans to introduce more advanced ballistic missile defense systems. Patriot antitactical ballistic missile (ATBM) capabilities will be improved with the addition of PAC-3 missiles and associated electronics improvements expected in late 1998 or early 1999. Navy Aegis destroyers are expected to be equipped with missiles modified to perform the "lower tier" ATBM role in 1999. Theater high altitude area defense

[1]David Hughes, "BMDO Under Pressure to Set TMD Priorities," *Aviation Week and Space Technology*, January 17, 1994, pp. 49-50.

(THAAD) missile systems for ballistic missile defense out to ranges considerably beyond Patriot are expected to reach Army field units in 2001.[2]

Limited funding and technical uncertainties have delegated three other ballistic missile defense programs to longer-term development. The Corps SAM (surface-to-air missile) program would provide mobile ATBM capabilities to U.S. Army forces. Either sea-based THAAD or the addition of Aegis ATBM missiles with LEAP (lightweight exo-atmospheric projectile) capabilities would give the Navy "upper tier" ATBM capability above the currently planned Aegis ATBM missiles. Finally, several options exist for a boost/ascent-phase ballistic missile intercept capability.[3]

THEATER MISSILE DEFENSE IN JAPAN

Concern about possible ballistic missile threats in Japan has been prompted primarily by the activities of North Korea.[4] In addition to concerns about its efforts to produce nuclear weapons, North Korea is also developing ballistic missile capabilities that would enable it to attack Japan. In May of 1993 North Korea test fired a ballistic missile 500 km into the Sea of Japan. This missile, Nodong-1, is believed to be capable of carrying a nuclear warhead and to have a range in excess of 1000 km, allowing it to strike western Japan. While some military experts question whether North Korea will be successful at developing and deploying a ballistic missile capable of delivering nuclear, chemical, or biological weapons, it would seem prudent for Japan to consider such a possibility.[5] Furthermore, while Japan currently enjoys stable relations with Russia and China, both nations possess nuclear ballistic missiles capable of striking Japan.

Japan already possesses or is procuring some rudimentary elements of a TMD system.[6] Patriot PAC-2 missile units are currently deployed in the air-defense role. Japan also has Aegis air defense systems and is procuring AWACS aircraft, both of which could be used as part of a TMD system. Nevertheless, each of these weapons systems would require upgrades to perform TMD functions. Furthermore, these assets might not be available for their current missions if they were deployed in a TMD role in the future.

Japan also has an indigenous development program known as "Future SAM" under way to develop medium-range surface-to-air missiles to replace U.S.-supplied Hawks currently used in the air-defense role. Future SAM, with production delivery scheduled to begin by the end of the decade and a total cost estimated at $4.8 billion, might play a role in a future TMD system.[7]

U.S.-Japan collaboration in the ballistic missile defense area goes back to the late 1980s, when several Japanese companies received contracts from DoD as part of the WESTPAC project, an initial study of ballistic missile defense requirements in the Western Pacific.[8] The Japanese government did not officially participate in WESTPAC.

Last year U.S. defense officials reportedly discussed a series of four possible TMD "options" with Japanese officials.[9] Although the options discussed in 1994 have been superseded by an

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[2]Ibid.

[3]Ibid.

[4]Susumu Awanohara, "My Shield or Yours?", *Far Eastern Economic Review*, October 14, 1993, p. 22.

[5]"North Korean Missile Eyed with Skepticism," *Aviation Week and Space Technology*, October 18, 1993, p. 101.

[6]Awanohara, op. cit.

[7]"North Korean Missile Eyed with Skepticism," *Aviation Week and Space Technology*, op. cit.

[8] Hironobu Sakamoto, "Japanese Firms Win SDI Research Contracts," *Japan Economic Journal*, December 17, 1988.

[9]Naoaki Usui, "Japan Tackles Antimissile Options," *Defense News*, August 29, 1994, p. 1.

ongoing joint study, they illustrate a variety of approaches that Japan might take should it decide to deploy a TMD capability. The approaches involve a variety of configurations of Aegis destroyers, Patriot firing units, and AWACS aircraft. Several of the options also include an advanced surveillance radar site and THAAD firing units. Estimated costs range from $4.4 billion to $15.2 billion.

In April 1995, the two countries launched a joint study of Japan's TMD requirements under the leadership of JDA. Should Japan decide to procure TMD capabilities following the study it could provide opportunities for U.S.-Japan cooperation in development and production. One possible area for cooperation would be codevelopment and coproduction of the "upper tier" ATBM missiles for the Aegis destroyers. In addition, the advanced surveillance radar could be developed and produced by the United States with opportunities for participation by Japanese subcontractors. U.S. development of the THAAD missile system is already under way, but some opportunities for Japanese participation in production might exist. U.S. development is already complete and production is under way for both the Patriot missile system and the AWACS aircraft, but Japanese participation in developing and producing the IRST (infrared search and track) targeting system for the AWACS might also be possible.

U.S.-JAPAN COOPERATION IN TMD

The United States has several important interests at stake in TMD cooperation with Japan, which might not be easy to reconcile as the project moves forward. First, from a basic security standpoint, Japanese deployment of TMD would contribute to the defense of Japan—for which the United States shares responsibility with Japan—and would protect U.S. forces stationed there as well as Japanese citizens. A second interest is possible technological benefits from joint development and related activities. If Japan decides to deploy TMD and wishes to license produce some of the component systems, resulting in a significant transfer of technology to Japan, the United States would likely pursue a reciprocal flow of technology from Japan to the United States.[10] This could take place through cooperative R&D on undeveloped systems or insertion of leading-edge Japanese technology into the TMD system. Finally, Japanese procurement would benefit the United States by allowing U.S. development costs to be spread over a larger production volume, and some savings could be realized if agreement can be reached on U.S.-Japan codevelopment of one or more of the component systems.

Although cooperation in TMD has a compelling logic and the possible benefits to both sides are clear, there are a number of potential challenges that must be overcome to structure a mutually beneficial program. One set of obstacles on the Japanese side is related to the lack of a political consensus in favor of deploying the system. Achieving such a consensus could be difficult. Despite the possible ballistic missile threat faced by Japan and the existing rudimentary elements of a TMD system, opposition exists to the very concept of TMD. TMD opponents claim that it would violate the parliamentary resolution banning the military use of space.[11] Others cite the costs of TMD and suggest Japan would be better off seeking to improve

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[10]When the possibility of implementing DoD's TFT initiative through TMD cooperation was raised by the United States early in the discussions of TMD, it was resisted by Japanese officials. The TFT and TMD discussions were "delinked" while Japan considers whether it wishes to deploy a system. See Barbara Wanner, "Washington Pushes for Expanded U.S.-Japan Defense Technology Exchanges," *JEI Report*, April 8, 1994, p. 6.

[11]Awanohara, op. cit. It should be noted that TMD would work without the use of space given a superior radar system.

diplomatic and economic ties with North Korea to head off a potential threat.[12] A further criticism that might apply in the event of Japanese codevelopment of a TMD system with the United States is that such cooperation would violate the constitutional ban against "collective defense" if the codeveloped system were applied by the United States for TMD activities elsewhere.[13] Finally, the necessity of Japanese participation in a TMD system could be questioned if there is a possibility of unilateral deployment by the United States to protect forces stationed in Japan.

Another possible set of obstacles in Japan centers on more narrow defense issues. For example, deployment of TMD by Japan would likely require a new level of interservice cooperation within the Self-Defense Forces (SDF). In addition, since defense budgets in Japan are tight and acquisition of TMD would involve considerable expense, it would be more difficult to acquire other systems with strong constituencies within the SDF. As has been the case at times in the United States, procurement decisions could be affected by the attitudes of the various services on the proper relative emphasis on fighters and missile systems for air defense.

Also, the attitudes of Japan's defense industry and the concerned organizations in JDA and MITI could raise complications. To begin with, while Japan can clearly afford TMD should it decide that the capability is a priority for future defense, the program would likely involve substantial purchases of U.S. equipment, even if some component systems are license produced. In a time of tight budgets, other potential Japanese programs—such as long-range transport aircraft or reconnaissance satellites or others—could have more industrial-base appeal and spinoff commercial benefits than TMD. While Japan is anxious to gain access to U.S. military technology, it is also wary of transferring Japanese commercial technology to the United States through defense cooperation.[14] Finally, Japanese industry and government remain wary about defense technology cooperation with the United States as a result of the FS-X experience.[15]

Pursuing a consistent and balanced U.S. strategy toward cooperation could be difficult in light of the various interests and stakeholders involved on both sides. Japan's resistance to the link between TMD and TFT illustrates one potential complication. At subsequent stages of discussion, U.S. efforts to negotiate a reciprocal technology flow could be opposed or misrepresented. Another possible challenge could arise if a U.S. approach focusing on the security and cost-spreading benefits of Japanese participation results in an agreement that draws opposition within the United States because of a perceived continuation of one-way technology transfers to Japan. The danger is that, as in the FS-X negotiation, the effort to cooperate with Japan could put strains on the overall U.S.-Japan security relationship without advancing other significant U.S. interests.

In short, TMD illustrates many of the opportunities and challenges facing the United States in adapting its defense technology relations with Japan and other allies to post-Cold War realities. The joint study of Japanese missile defense needs led by JDA is ongoing as this is written. The advance consultation occurring through this study could contribute a great deal to achieving a high level of mutual understanding between the defense establishments and smooth the way for possible future collaboration. This understanding could be essential when Japan considers whether to deploy the system and if any of the issues outlined above reemerge. On the U.S. side, an appreciation of the interests of the various Japanese players, careful planning, and extensive consultation among the relevant U.S. government agencies and between government

[12]Sadao Sakai, "Improbable Missile Defense," *The Japan Times*, September 12, 1993, p. 18.
[13]Awanohara, op. cit.
[14]"Technology Flow to U.S. Raises Concerns," *Nihon Keizai Shimbun*, May 9, 1994, p. 1.
[15]Awanohara, op. cit.

and industry will likely be necessary in order for TMD cooperation to contribute to an expanded and revitalized U.S.-Japan alliance.

Appendix E

U.S.-Japan Industrial Relationships in the Aegis Foreign Military Sales Program[1]

David T. Gross

BACKGROUND

Aegis is a complete shipborne multiwarfare combat system that includes detection, command and control, weapon, and support systems for the Aegis-class of guided missile cruisers and destroyers. The Aegis weapon system is the antiair warfare part of the combat system and also has the function of integrating the combat system. This computer-controlled weapon system has by far the most capable tactical radar system put to sea—the AN/SPY-1 phased array radar. SPY-1 can automatically track multiple targets simultaneously while maintaining surveillance of the surrounding air space. Navy Standard Missiles (SM-2) are fired and directed at the selected targets. The improvements over previous systems include the ability to reliably engage multiple targets in a hostile environment. Aegis is a U.S. Navy (USN) program that includes CG-47 Ticonderoga-class cruisers and DDG-51 Arleigh Burke-class destroyers. Development started in 1970 on an antiair warfare (AAW) system and was later expanded to a combat system resulting in the two classes of Aegis ships. The cruiser program construction started in 1978 is now complete with 27 ships in operation. The destroyer program, with construction starting in 1985, is in the build-up phase with 32 authorized out of a planned 57 Aegis destroyers. Under a ship program manager (PMS 400), the USN created a consolidated ship/combat management structure with emphasis on total ship performance. USN PMS 400 is assisted by Lockheed Martin as the combat system engineering agent and two shipbuilders, Ingalls Shipbuilding and Bath Iron Works. The USN has forged a team with Navy and industry people working to build the best possible Aegis ships. This has resulted in a close working relationship between the shipyards and Lockheed Martin with information passing directly between the shipyards and Lockheed Martin without a formal USN review.

Japan is presently the only other country that has the Aegis system. The Aegis foreign military sales (FMS) efforts began in 1984, resulting in the first Japanese FMS case in 1988. Three additional FMS ships were then authorized in 1990, 1991, and 1993. The Aegis FMS programs are different than USN programs in that PMS 400 is not responsible for the ship hull and machinery or the antisubmarine warfare (ASW), electronic warfare (EW), and gun systems. The USN furnishes the Aegis AAW system and selected combat system elements, but the ship and the other remaining systems are built in Japan. Not all portions of the U.S. Aegis system are installed on the Japanese ship. The Tomahawk system is not exported, and there is no equivalent Japanese-supplied function. Several other functions are also deleted in the Japanese ship. The USN had earlier furnished TARTAR systems (the predecessor of Aegis) via FMS to Japan. The

acquisition of Aegis required the Japanese to learn a new and much more complex system than TARTAR.

PROBLEMS AND CHALLENGES

The U.S. Congress approved the Aegis sale to Japan in 1988 despite reservations about the transfer of technology. Special congressional concerns were related to the SPY-1D radar technology and the associated complex real-time computer programs. The USN responded to these concerns with additional constraints on the transfer of technology, as delineated in a memorandum of understanding (MOU) between the U.S. and Japanese governments. Releasability considerations are a critical aspect of the Aegis FMS program. *Everyone* from the Aegis program who interfaces with the Japanese must understand the restrictions to ensure that the letter and spirit of the MOU are strictly followed.

The USN and Lockheed Martin over the years have developed methods to get well-prepared Aegis ships to sea as quickly as possible. Since the United States and Japan provide approximately equal shares of the program (the USN supplies Aegis and other systems while the Japanese supply the ship and major combat system elements of an integrated system), the management approach was crucial. The first task in this approach was convincing the Japanese Maritime Self-Defense Force (JMSDF) personnel that Aegis procurement had different management requirements than their previous TARTAR programs because of the number and complexity of the system interfaces. This was accomplished early, but because of personnel changes in the JMSDF it remains a continuing effort.

The next set of problems was the interface with the Japanese manufacturers. The first involved the shipbuilder. Because of the complexity of the system and the alignment and support systems, a number of Lockheed Martin people have been located at U.S. shipyards to support ship design and installation to be part of a USN Aegis test team (ATT). This team stays in close communication with experts in the Moorestown, New Jersey home office. In Japan the shipbuilder was responsible for all of these functions. The Japanese shipbuilders' first response was to ask for the equipment, the manuals, some training, and on-call technical support as required. This was also the first reaction of U.S. shipyards. However, in the United States, PMS 400 manages the ship contracts. In Japan it was necessary to convince the shipyard that a different approach, similar to that used by the USN, was required.

Another set of interfaces is the Japanese manufacturers of the ASW, EW, and gunfire control systems. These systems are integrated in USN Aegis ships, and it was the desire of JMSDF to also integrate them on their ship. Since these were existing or upgraded systems, they could not be redesigned to match the computer interfaces of the U.S. counterpart. It was necessary to negotiate new or revised interfaces with Japanese manufacturers, JMSDF, USN, and Lockheed Martin.

One of the reasons for the great success of the Aegis program has been the policy to test equipment and computer programs thoroughly before delivering them to the shipyard. In new versions of the system this is accomplished primarily at the combat system engineering development (CSED) site in Moorestown. It was not possible to send systems from Japan to test at the CSED site. Leaving this complex digital interface testing to the shipyard test cycle was not an acceptable practice because of the compressed schedule and the number of technical experts

needed to solve these problems. Thus, interface testing was of great concern. The Japanese shipbuilders and suppliers of equipment with complex computer interfaces are listed below:

- *Shipbuilders*
  - Mitsubishi Heavy Industries (MHI)—Nagasaki
    - DDG 2313, DDG 2314, DDG 2315
  - Ishikawajima-Harima Heavy Industries (IHI)—Tokyo
    - DDG 2316

- *Manufacturers*
  - Hitachi—Totsuka
    - ASW control system
  - Mitsubishi Electric Company (MELCO)—Kamakura
    - gunfire control system
  - MELCO—Amagasaki City (Osaka)
    - EW system

The problem of communications between the U.S. and Japanese participants continues. We started with people who understood Aegis but had little or no international experience. Although our Japanese counterparts were more or less fluent in English, there were many difficulties in coming to a common understanding and knowing when understanding had been achieved. Our communications skills needed work.

As an overlay on the technical, language, and cultural differences, there is a releasability policy that requires very close attention. In practice it is not possible to have the USN involved in every technical interchange. For example, there was a set of ship installation criteria that was transferred from Lockheed Martin to USN to the American Embassy in Tokyo to JMSDF and then to the shipbuilder. When the shipbuilder has questions about these criteria, the time required to use the formal channel for questions and answers would disrupt the shipbuilding program. Other solutions were required.

IMPLEMENTATION

The program was initiated through the Mutual Defense Assistance Office (MDAO) in the American Embassy in Tokyo. MDAO provided advice and conference rooms, attended meetings, and helped with translations and introductions to the JMSDF. As the program grew, it was more convenient to use nearby Lockheed Martin offices and conference rooms, although the embassy is still used for classified meetings. The MDAO function was essential for start-up and provides continuing support for the program.

Initial meetings were used to explain the Aegis system and the implementation techniques used in the United States to assure system performance. Most of the early questions and comments from JMSDF concerned performance and requests for studies or data on our recommendations. (When "our" is used it means a U.S. approach. Otherwise, separate U.S. points of contact might confuse the Japanese with somewhat different answers. Conversely, the Japanese discuss answers among themselves for extended periods during a meeting to arrive at a

consensus answer.) The most difficult problem was to address the concept of an Aegis test team in the shipyard. JMSDF contracts with the shipyards through the JDA's Central Procurement Office (CPO). The shipyard is responsible for all building, installation, and testing until the ship is turned over to JMSDF at commissioning. The CPO oversees the work and accepts the ship. In this environment how could we place a USN team into a Japanese commercial shipyard? After considerable discussion, the USN offered to help establish an integrated test team (ITT) managed by the shipyard but partially manned by Lockheed Martin employees. The initial breakdown was a 55-man team with 34 Lockheed Martin and 21 shipyard members. Since the ships' crew are not permitted to operate the equipment in the shipyard, we agreed to operator training for additional shipyard people to operate consoles during the peak of testing. The shipyard ITT members were given extensive training in Moorestown and at Ingalls Shipyard with an Aegis test team. The Japanese shipyard agreed to supply office space for the U.S. members of the ITT. Eventually, the combined ITT was collocated in an office area by the waterfront.

The Lockheed Martin office in the MHI Nagasaki shipyard was opened on April 13, 1989, with a planned buildup of four people during the design phase, 12 people for installation, and then a crew of 34 during the test phase. In practice, the shipyard generally matched our people one for one during the test program. This buildup occurred in 1990-1991 and the first half of 1992. The test period was longer than presently achievable in U.S. shipyards but shorter than our first ship of a class. A direct link from the shipyard to Moorestown, established through discussion between USN and JMSDF, allowed swift response to shipyard questions. Because of the success of this communications link, the transfer of technical data and other issues, a formal Navy procedure was issued by PMS 400, including the following guidelines:

- All drawings, ship interface criteria and test procedures go through formal Navy-to-Navy channels.

- A liaison information transfer report (LITR) procedure is established for Lockheed Martin to directly answer MHI's questions on the data formally transferred.

- Nonreleasable data may not be transferred by LITR.

- Any information that could affect program costs or the schedule must go through formal channels.

- Copies of LITRs are sent to PMS 400 at the same time they are sent to Japan.

Many of the LITRs concern detailed questions on data already provided and questions on alternate methods to implement the specified functions. Also, there were a number of comments on shipyard-provided drawings of combat system spaces. There were both large and small problems uncovered in these reviews. PMS 400 stayed very close to the shipyard effort, which tended to strengthen our position in the shipyard. (In Japan, USN advice and comments are treated with great respect.)

The manning of the ITT was given considerable attention. People had to be interested in residing in Japan as well as being technically qualified. A cultural training course was given to long-term members and their families. Considerable assistance was supplied by the shipbuilder in

finding housing and other needed items. Releasability briefings were given by the Navy and were repeated periodically. The permanent members of the ITT were sent to Japan under USN Technician Orders, which put them under nominal oversight of MDAO in Tokyo. It was emphasized to each ITT member that he or she was being sent as a representative of the USN *and* Lockheed Martin. U.S. security in Japan briefs U.S. ITT members twice a year in addition to visits by Lockheed Martin security. There are a number of Lockheed Martin and PMS 400 management visits to Japan to support and encourage the team. During the initial start-up phase, we did not know how to make an international ITT work effectively but sent only qualified and enthusiastic people to ensure success. Considerable attention was given to assure USN and Lockheed Martin home office support of the team.

The results were better than expected. The first ship, JDS Kongo, meeting all Japanese construction and test requirements, was commissioned on March 25, 1993, with all of the USN-supplied systems operational. Both JMSDF and the shipyard were very pleased. In the process a very effective international team evolved that worked the many problems to successful solutions. In retrospect the key factors that led to this outcome were:

- a motivated team effort by highly competent people with Aegis experience,
- a highly skilled and cooperative shipbuilder,
- engineer-to-engineer discussions with the Japanese technical counterparts in all phases of design,
- drawing reviews with the shipbuilder,
- joint advanced planning of the ship installation and test program in great detail,
- ship construction was completed before the start of testing,
- timely logistics support,
- JMSDF and USN encouragement and support, and
- a number of related actions taken early—some of which are described below.

A critical area of technical cooperation was with the Japanese manufacturers of the ASW, EW, and gunfire control systems. Aegis interfaces have been defined for the U.S. systems but needed to be defined for the Japanese counterparts. The general rule was that the Aegis interface was to remain unchanged. However, differences in function made changes necessary. The most complex interface was the integrated ASW control system that was being developed based on an existing Japanese system. The early discussions involved the equipment configuration. The manufacturer was prepared to supply its own computer and display. However, in the Aegis systems, common displays are used in the combat information center (CIC) for most functions, including ASW. In addition, since it was a complex interface, it was desirable to test the system at the CSED site in Moorestown to ensure compatibility. JMSDF decided that its ASW control system would have USN-supplied computers, peripherals, and displays and that the Japanese manufacturer would use them in development. (There were licensed production agreements being negotiated or in place to manufacture this equipment in Japan.) This allowed testing of the Japanese configuration at CSED. A set of ASW control system equipment was ordered for CSED. The Japanese manufacturer developed the computer programs and supported testing with their engineers at the CSED site. We were visited several times by Japanese management to discuss problems and assess the CSED site test progress. The testing at the CSED site proved

valuable when shipyard testing started. The ASW control system interface integration went smoothly with fewer problems than other interfaces, even though it was by far the most complex.

The gunfire control system (GFCS) was the next most complex interface. The manufacturer had an existing program that it was modifying to match our interface. Since the design was different from the USN system, modifications were required in the interface. The message interface protocol was sent on tape by MELCO to CSED, and message initiations were accomplished. This system required the most work in the shipyard to integrate but was not a major issue. The EW system integration had some problems in the shipyard, but again they were not an issue.

The early integration work on ASW, EW, and GFCS used a common technical approach. Interface design specifications (IDS) had been previously established for the U.S. equipment interfaces. These IDSs were modified to accommodate the Japanese systems. This was accomplished with a series of meetings in Tokyo. The early meetings involved policy decisions by both Navies as to the functions to be kept, changed, or deleted. These decisions were documented in meeting minutes (in English) and were distributed to the participants. After policy was decided, a regular set of quarterly meetings in Tokyo was established. The IDS provisions were discussed in increasing detail as the meetings progressed and resulted in a set of IDSs signed by the Japanese manufacturer, JMSDF, USN, and Lockheed Martin. We then put the documents under strict configuration control. We also started a quarterly management review that followed the technical meetings. Technical progress, shipyard progress, and special topics were covered at the quarterly management reviews. This was the only forum for problems affecting the total ship program and was the only view the Japanese manufacturers had of the overall program.

The U.S.-Japan communications problem was worked out at Lockheed Martin in Moorestown. Much literature on doing business with the Japanese was reviewed and some was relearned through experience. Guidelines were set up for presentations and responses to the Japanese. Material was reviewed, and new people were briefed before they went to Japan. Considerable effort was expended in preparing for the trips to Japan. This preparation helped considerably in solving the technical interface problems.

BENEFITS TO THE UNITED STATES

There are several cost benefits from the Aegis FMS sale to Japan. First, there is the payback of a share of the development costs of the Aegis program. The FMS program also reduces the cost of the USN Aegis program through larger production quantities and by paying its fair share of the common overhead function in the project. As the Aegis FMS project is now over $2 billion, the benefits are appreciable.

We have learned different ways to conduct business. An example is the number of people involved. We tend to have a number of specialists to handle different kinds of problems. The JMSDF and the Japanese manufacturers have a limited number of people who have project responsibility. To interface with this smaller group, we have cross-trained our people to perform multiple tasks, which makes them more valuable and makes the process more efficient.

Despite the extensive technical interchanges that occurred, there has been little conventional technology transfer because of the restrictions on both sides. However, our shipyards have had

the opportunity to observe a Japanese shipyard build an Aegis ship and to adopt the applicable techniques.

The training of a large group of U.S. engineers and managers to operate in an international environment is certainly of great potential benefit to Lockheed Martin and the other U.S. companies that support the Aegis project.

BENEFITS TO JAPAN

The most obvious benefit is the upgrade of the JMSDF with the most capable warships in the world. With its emphasis on defense, it closely matches the stated future goals of the JMSDF.

JMSDF, its shipbuilders, and its manufacturers have learned a considerable amount about the integration and testing of a large modern complex weapons system by working on the Aegis program. The shipbuilder was responsible for testing in the shipyard, and the ASW control system manufacturer spent considerable time at the CSED site learning integration techniques as well as testing the system. This will provide better insights into integration of their own ships. (Presently Japan builds small ships with their own systems and depends on the USN for large ship antiair warfare systems.)

ISSUES

When the Aegis FMS program went through congressional review of the release to Japan in early 1988, there were two major issues raised. The first, supported by the U.S. shipbuilding industry, was why a total Aegis ship was not supplied to Japan instead of just the Aegis weapon system. This would give the depressed U.S. shipbuilding industry some badly needed work in return for the release of this advanced system to Japan. While this was a good idea, there were other factors to consider. In Japan the shipbuilding industry was also depressed. The earlier TARTAR system release to Japan had also involved the sale of the antiair warfare system with the ship built in Japan. Since the FMS program would take half of the budget for the Japanese ship and several Japanese systems were to be installed (U.S. systems were not released to Japan), it was not likely that Japan would buy Aegis as a total ship.

The second issue raised in Congress was whether Aegis should be released to Japan at all. Many members believed that our latest technology should not be released to Japan. There was a concern that the Japanese might "reverse engineer" the system and build it themselves in the future. As a result of these concerns, additional restrictions were put on the Aegis sale. The restrictions were to discourage reverse engineering of the system while allowing its use by Japan. The arguments for the release to Japan included Japan's status as a close ally in the Pacific and a potential reduction in the number of ships the USN would have to deploy in the Western Pacific as Japan increased its capability with Aegis. Several high-level USN officers testified before Congress on the conditions of the release of Aegis to Japan. (The congressional record of this testimony provided our first releasability guidelines.) After debate, the release was approved and an MOU on Aegis was written and signed by both countries.

There may still be some lingering discontent within JMSDF over some of the releasability guidelines.

In conclusion, the Aegis FMS program has proven that the United States and Japan can collaborate effectively on a complex challenging military program. Hard work, attention to detail, and superior personnel from both countries were necessary to achieve this success. The lessons and mutual respect built through the experience could be usefully applied to future U.S.-Japan collaboration.

Appendix F

Marketable Technology Permits: An Alternative Approach

Note: In formulating its conclusions and recommendations, which appear in Chapter 7 and in the report's Executive Summary, the Defense Task Force (DTF) explored and discussed a number of alternative approaches and options. For the most part, these alternatives are discussed in Chapter 6 as part of developing the rationale for action items the DTF decided to endorse. In addition to these options, DTF was also presented with the concept of using marketable technology permits to facilitate U.S.-Japan dual-use technology flows.[1] *Following a discussion of the concept, the committee decided not to endorse this idea. However, because it represents a new and direct approach to the problem, DTF decided that it would be useful to include a brief discussion of the marketable permits concept in this appendix.*

The concept of marketable permits for U.S.-Japan dual-use and defense technology transfers is adapted from the field of environmental economics, where it has been put into practice in a number of areas. There are three main points to the plan. First, Japanese firms that sell dual-use technologies to U.S. firms would receive a permit from the U.S. Department of Commerce to buy U.S. defense technologies. The permit would record the monetary amount of the transaction between the U.S. and Japanese firms. Second, these permits would be marketable in Japan, preferably on a stock or commodities exchange, so that a company desiring U.S. defense technologies but lacking the requisite permit could buy them from the exchange. Third, these permits would be required for Japanese firms to receive U.S. defense technologies.

Such a plan addresses several of the issues complicating U.S.-Japan dual-use technology collaboration. First, it creates an explicit linkage between the defense and commercial sectors throughout the Japanese economy. There may only be a limited number of firms that have mutual interests in each other's technology. The permit system would allow for a Japanese dual-use technology to be transferred to the United States by one firm, while another Japanese firm receives U.S. defense technology, without either government having to get involved directly.

Second, the burden for balancing the technology transfers would be placed on the Japanese private sector, reducing the need for U.S. firms to lobby for dual-use technology licenses. Before a U.S. defense technology could be transferred to Japan, a dual-use technology transfer from Japan would have to have occurred. The hope is that Japanese firms would start contacting U.S. firms with dual-use technologies that they wish to sell, eliminating the costly need for U.S. firms to search the Japanese economy.

A marketable permits system has several additional virtues, in that it could be phased in and fine tuned over time, U.S. government coordination requirements would be minimal, and measuring progress in achieving reciprocal technology flows would be straightforward.

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[1]A more detailed discussion of the concept is contained in James Chung and Richard J. Samuels, "Facilitating the Transfer of Dual-Use Technology from Japan Through the Use of Marketable Permits," briefing paper for the Defense Task Force, 1995.

In considering the marketable permits idea the Defense Task Force noted several complications. One involves valuation of the permits. Most arms-length technology deals are not valued in lump sums but are contracted as a percentage of a resulting future stream of revenue. A second complication might lie in defining dual-use technologies. Unless the definition stipulated a very clear criterion—such as requiring utilization on a DoD contract—issuance of an approved list of dual-use technologies and an approval bureaucracy might be required. Perhaps the most important complication involves the ultimate implications for wider U.S. interests of introducing a new export control regime.

Although most of the complications could perhaps be addressed, the DTF decided not to endorse the marketable permits concept. As a new and direct approach to the issues discussed in the report, the DTF believes that including a discussion of the idea in this appendix will be useful in stimulating discussion.